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The anti-aging secrets of Japanese executives

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Abstract

Objective: The cumulative results of healthcare screening, additional tests related to aging (bone density, vascular age, and blood hormone levels) and a subjective symptoms questionnaire (Anti-aging Quality of Life Questionnaire) were studied to access the health status of Japanese executives.
Methods: Forty-nine male executives were examined. Adding to general test items, bone density test (DEXA method), Digital plethysmography, serum IGF-I, DHEA-S and cortisol were measured and compared with the age-matched control group.
Results: Blood examination results of the executives were not different from the control group, except for gamma GTP. In the executives, the physical and mental symptoms for aging and QOL were significantly better, bone mineral densities were significantly higher, and the serum IGF-I levels were higher than control. There were no significant differences in DHEA-s; however, the stress hormone, cortisol, was significantly higher in the executives.
Conclusions: Physiological age of Japanese executives seemed to be a better indication of suitability of employment and performance on the job than chronological age. The Anti-aging Quality of Life Questionnaire showed that executives must overcome mental weaknesses such as "depressed," "pessimism," and "feeling of anxiety for no special reason" to remain in their posts even after old age and actively fulfill their responsibilities. Age-related testing will contribute to a more accurate assessment of corporate executives as to their actual employment potential and health status.

Key words: anti-aging medicine, industrial physicians, IGF-I, DHEA, bone density, arteriosclerosis

Introduction

The objective of anti-aging medicine is to live long in good health. It is a medical treatment aimed not simply to prolong a person's life but to live healthily and happily while preventing physical and mental deterioration caused by aging and maintaining his or her quality of life (QOL) at a high level[1-3]. Medically, it is classified under prophylactic medicine. A checkup/screening for assessing the degree of aging is available as a means of diagnosis, while a range of treatment options is available including diet, exercise and other lifestyle therapies, drug therapies including nutritional supplement therapies, and hormone replacement therapies. Anti-aging medicine is equally important to all physicians, regardless of their status, such as practitioners, hospital physicians, industrial physicians or medical school professors. If industrial physicians who have the opportunity to be involved with industrial health and hygiene take an active role in promoting the health of corporate workers, it will bring about benefits to employees in the form of reduced absenteeism, enhanced productivity and higher QOL. Corporations can also enjoy tremendous

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benefits, such as improved business performance and reduced spending by corporate health insurance unions.

Over the years, we have been involved with health insurance operations and health/hygiene programs of workers at a Japanese steel manufacturer, in collaboration with its health insurance union and industrial physicians (this company was ranked among the world's top 4 in terms of crude steel production in 2003). Interest in and understanding of anti-aging medicines have grown among the general public in recent years, and we are seeing moves to actively incorporate anti-aging medicine on a corporate level as well. In 2003, a comprehensive medical checkup program to assess the degree of aging (anti-aging checkup program) was established at our hospital, targeting corporate directors. We recently compiled the results of clinical tests performed with board directors of major corporations, and compared them with healthy populations (age- and sex-adjusted). Our findings are reported herein.

Methods

The subjects of our study were 49 men who were examined at this facility between October 2003 and March 2004. Their mean age was 59.5±5.6 years (mean±SD). As comparative controls, we used 95 healthy men who had undergone complete medical examinations at this facility at about the same period (whose sex-specific ages had been adjusted; their mean age was 58.9±9.0 years), and designated them the Control Group.

Table 1 shows the test items. In other words, besides the general health check items, various tests related to anti-aging medicine were also performed.

Subjective symptoms were assessed, using a common questionnaire on aging and QOL (the AAQoL Questionnaire, supervised by the Japan Anti-Aging Foundation, an NPO), and evaluations were made on a scale of 1 to 5 (1: None at all, 2: Almost none, 3: Slightly, 4: Moderately, and 5: Severely)[2-3]. Besides general blood biochemical tests, the serum level of hormones related to aging and QOL was measured, including dehydroepiandrosterone sulfate (DHEA-s), insulin-like growth factor-I (IGF-I), and cortisol. These blood tests were performed in the morning under fasting conditions. Vascular age was measured using digital plethysmography (8DP-100; Fukuda Electronics, Tokyo).[4] Bone density was measured using a dual energy X-ray absoptiometry apparatus (DEXA) (QDR-4500A; Hologic, MA, USA) as a mean value of the lumbar spine Nos. 2 to 4, and bone age was calculated from the standard curve.[5]

The results were shown either as mean±SD or as a correlation coefficient, with $p < 0.05$ made the significant difference. The t-test, the rank sum test, and the correlation coefficient's significant difference tests were used to conduct statistical analyses.

Table 1. Test items

- General test items
- Common questionnaire sheet on aging and QoL
- Bone density test (DEXA method)
- Digital plethysmography (tests for the degree of arteriosclerosis; vascular age)
- Special blood tests (hormones that affect aging and QoL)
  - IGF-I (insulin-like growth factor-I or somatomedin C)
  - DHEA-S (dehydroepiandrotesterone)
  - Cortisol (stress-related hormone)

Results

Tables 2 to 5 show the survey items used for the executives and the Control Group (men of similar generation whose age makeup had been adjusted).

Regarding general test items, no significant differences were seen between the executives and the Control Group in terms of height, weight, blood pressure, sugar metabolism or lipid metabolism (Table 2). As for hepatic function, although the two groups showed no significant differences in their serum GOT and GPT values, the executives had significantly higher serum γ-GTP levels ($p < 0.05$).

Tables 3 to 4 show the results of the survey using the common questionnaire on aging and QOL (AAQol). Regarding physical symptoms, the executives were shown to be superior to the Control Group in 8 out of the 30 items,

Table 2. General test items

(n)	Executives (49)	Control (95)	(n)	Executives (49)	Control (95)
Age	59.5±5.6	58.9±8.9	TC (mg/dl)	211.6±32.1	210.7±33.0
Height (cm)	170.4±6.5	167.5±7.0	HDL (mg/dl)	53.2±12.9	57.5±16.3
Weight (kg)	69.5±7.6	66.4±10.8	LDL (mg/dl)	121.8±26.3	123.2±27.1
BMI	23.9±2.3	23.6±2.7	TG (mg/dl)	148.4±83.9	124.7±122.1
Body fat percentage(%)	23.0±4.9	20.7±4.7			
Systolic pressure (mmHg)	135.1±15.2	131.6±14.4	BS (mg/dl)	109.1±18.1	104.8±18.3
Diastolic pressure (mmHg)	83.3±9.0	80.6±9.1	HbA1c (%)	5.3±0.6	5.1±0.7
GOT (U/l)	25.1±6.0	25.6±8.5	(mean±SD, *p< 0.05 vs. control, t-test)		
GPT (U/l)	26.9±12.2	25.6±13.3			
γ-GTP (U/l)	71.7±61.6*	42.4±36.8			

Table 3. Physical symptoms

	Executives	Control		Executives	Control
Tired Eyes	2.6±1.0	2.6±1.0	Liable to catch colds	2.0±0.8	2.0±0.9
Blurry eyes	2.0±0.9	2.2±1.0	Coughing and sputum	2.2±0.9	2.2±0.9
Eye pain	1.5±0.7	1.5±0.8	Diarrhea	1.8±0.8	2.0±1.0
Stiff shoulders	2.3±0.9	2.6±1.3	Constipation	1.7±1.2	1.9±0.9
Muscle pain/stiffness	1.9±0.7	2.5±1.2	Headache	1.4±0.6**	1.9±0.8
Palpitations	1.7±0.8	1.8±0.9	Dizziness	1.6±0.8	1.8±0.7
Dyspnea	1.9±1.1	1.9±1.0	Tinnitus	1.4±0.7*	2.2±1.1
Tendency to gain weight	2.4±1.2	2.6±1.3	Lumbago	2.8±1.2	2.8±1.2
Weight loss; thin	1.4±0.8	1.6±1.0	Arthralgia	2.0±0.9	2.3±1.1
Lethargy	1.8±0.7	2.2±1.0	Edematous	1.4±0.7**	1.8±0.8
No feeling of good health	1.7±0.7*	2.1±0.9	Easily breaking into a sweat	2.1±1.1**	2.8±1.2
Thirst	1.8±0.8	1.9±0.9	Frequent urination	2.1±1.1	2.4±1.2
Skin problems	1.4±0.6**	2.1±0.9	Hot flash	1.4±0.5	1.8±0.8
Anorexia	1.3±0.5	1.6±0.7	Excessive sensitivity to cold	1.3±0.5*	1.9±1.1
Early satiety	1.6±0.5	1.9±0.9			
Epigastralgia	1.3±0.5*	1.7±0.8	(mean±SD, *p < 0.05 . **p < 0.01 vs control, rank sum test)		

with their scores being significantly lower than those of the Control Group (Table 3). The eight items were as follows: no feeling of good health, skin problems, epigastralgia, headache, tinnitus, edematous, and easily breaking into a sweat. As for mental symptoms, the executives were superior to the Control Group in 12 out of the 21 items, with their scores significantly lower than those of the Control Group (Table 4). The twelve symptom items were as follows: irritability, Easily angered/short-tempered, loss of motivation, no feeling of happiness, nothing to look forward to in life, daily life is not enjoyable, loss of confidence, depressed, a feeling of uselessness, pessimism, difficulty falling asleep, and a sense of tension.

Table 5 shows the results of the bone density tests, vascular age, and blood hormone tests. The bone density and age of the executives were 1.06±0.15 g/cm^2 and 52.9±15.2 years, respectively, and those of the Control Group were 0.99±0.17 g/cm^2 and 58.2±17.7 years, respectively, showing that the executives had significantly higher bone density ($p < 0.01$) and significantly lower bone age ($p < 0.01$). Vascular age, one of the indicators of arteriosclerosis, was 58.0±10.4 years for the executives and 55.7±9.7 years for the Control Group, showing no significant difference between the two groups. Regarding

Table 4. Mental symptoms

(n)	Executives (49)	Control (95)	(n)	Executives (49)	Control (95)
Irritability	2.0±0.8**	2.4±0.9	Pessimism	1.6±0.7**	2.2±1.0
Easily angered/short-tempered	1.9±0.9**	2.5±0.9	Lapse of memory	2.4±0.9	3.0±0.8
Loss of motivation	1.5±0.7**	2.1±0.9	Inability to concentrate	1.9±0.6	2.1±0.8
No feeling of happiness	1.6±0.6*	2.0±0.9	Inability to solve problems	1.6±0.6	1.9±0.7
Nothing to look forward to in life	1.5±0.6**	2.0±1.0	Inability to make judgements readily	1.5±0.6	1.9±0.7
Daily life is not enjoyable	1.5±0.6**	2.0±0.8	Inability to sleep because of worries	1.6±0.8**	2.1±1.0
Loss of confidence	1.5±0.6*	1.8±0.8	A sense of tension	2.1±0.9*	2.4±1.0
Reluctance to talk with others	1.6±0.6	1.8±0.8	Feeling of anxiety for no special reason	1.4±0.6	1.8±0.7
Depressed	1.5±0.6*	1.8±0.8	Vague feeling of fear	1.3±0.5	1.7±0.7
A feeling of uselessness	1.4±0.5**	1.9±0.9	(mean±SD, *p < 0.05 **p < 0.01 vs. control, rank sum test)		
Shallow sleep	2.1±0.9	2.4±1.2			
Difficulty falling asleep	1.5±0.7	2.0±1.2			

Table 5. Bone age, vascular age, hormone age

(n)	Executives (49)	Control (95)	(n)	Executives (49)	Control (95)
Bone density (g/cm^2)	1.06±0.15**	0.99±0.17	DHEA-s (ng/ml)	1621±774	1659±981
Bone age	52.9±15.2**	58.2±17.7	Cortisol (μg/dl)	16.9±6.9**	13.2±4.8
Vascular age	58.0±10.4	55.7±9.7	DHEA-s/cortisol	114±95*	78±43
IGF-I (ng/ml)	198.3±57.8**	172.1±50.4	(mean±SD, *p < 0.05, ** p < 0.01 vs. control, t-test)		

Table 6. Correlation with chronological age (correlation coefficient)

	Executives	Control		Executives	Control
(General test items)			Mentally irritated	-0.29*	-0.14
Height	-0.30*	-0.40**	Lose confidence	-0.32*	-0.08
Weight	-0.33*	-0.42**	Depressive#	-0.41**	-0.03
BMI	-0.15	-0.29*	Pessimistic#	-0.39**	0.14
Body fat percentage	-0.08	-0.29*	Anxious without reasons#	-0.44**	0.21
Systolic pressure	0.45**	0.29**	**(Bone age, vascular age)**		
Diastolic pressure	0.15	0.17	Bone density	0.22	0.09
Hb	-0.35*	-0.06	Bone age	-0.07	0.09
GOT	-0.10	0.14	Vascular age	0.41**	0.60**
GPT	-0.11	-0.10	**(Hormone age)**		
γ-GTP	-0.12	-0.31**	IGF-I	-0.12	-0.29**
TC	-0.24	-0.01	DHEA-s	-0.41**	-0.48**
HDL	0.02	0.03	Cortisol	0.16	0.11
LDL	-0.30*	-0.03	DHEA-s/cortisol ratio#	-0.18	-0.50**
TG	-0.22	-0.14			
BS	0.27	0.20*			
HbA1c	0.30*	0.38**	(Correlation coefficient: test with non-correlation *p < 0.05 **p < 0.01)		
(Mental symptoms)			(Test of correlation coefficient #p < 0.01)		
Overweight	-0.34*	-0.07			

hormone tests, the serum IGF-I value was 198.3±57.8 ng/ml for the executives and 172.1±50.4 ng/ml for the Control Group, showing that the former had an approximately 15% higher value than the latter ($p < 0.01$). The serum DHEA-s value was 1621±774 ng/ml for the executives and 1659±981 ng/ml for the Control Group, showing no significant difference between the two groups. The serum cortisol value, one of the markers of stress load, was 16.9±6.9μg/dl for the executives and 13.2±4.8 μg/dl for the Control Group, showing that the former were exposed to significantly higher stress than the latter ($p < 0.01$). However, a look at the ratio between DHEA-s and cortisol (DHEA-s/cortisol) shows that the executives had significantly higher values than the average for the same-generation men ($p < 0.05$).

Next, the correlation between chronological age and each of the factors studied in this survey was investigated. The results are shown in Table 6.

Items that showed a correlation with chronological age in corporate executives included systolic pressure, HbA1c, and vascular age, while those that showed a reverse correlation were height, weight, Hb, LDL and DHEA-s. Systolic pressure, vascular age, and DHEA-s, in particular, showed a correlation coefficient (absolute value) exceeding 0.4. The executives showed no significant reduction in IGF-I with age. Cortisol levels were not correlated to chronological age.

Items that showed a correlation with the chronological age in the Control Group included systolic pressure, BS, HbA1c, and vascular age, while those that showed a reverse correlation were height, weight, BMI, body fat percentage, γ-GTP, IGF-I, DHEA-s, and the DHEA-S/cortisol ratio. Height, weight, vascular age, and the DHEA-S/cortisol ratio, in particular, showed a correlation coefficient (absolute value) exceeding 0.4.

Of the scores obtained in the common questionnaire on aging and QOL (AAQol), none of the physical symptom items showed a significant correlation with chronological age. Regarding mental symptoms no items showed a significant correlation to chronological age in the Control Group. The executive group scores for "tendency to gain weight," "irritability," "loss of confidence," "depressed," "pessimism," and "feeling of anxiety for no special reason" showed a significant reverse correlation to their chronological age. "Depressed" and "feeling of anxiety for no special reason," in particular, showed a correlation coefficient (absolute value) exceeding 0.4.

A test for correlation coefficient between the corporate executives and the Control Group showed a significant difference ($p < 0.01$) for three items, namely, "depressed" (executives: $r = -0.41$ versus Control Group: $r = -0.03$), "pessimism" (executives: $r = -0.39$ versus Control Group: $r = 0.14$), and "feeling of anxiety for no special reason" (executives: $r = -0.44$ versus Control Group: $r = 0.21$). In other words, among corporate executives, the older they became, the fewer mental symptoms they suffered, but among the Control Group, no age-related changes were seen, indicating that these differences were significant.

Regarding hormone tests, the Control Group showed a significant age-related reduction in IGF-I ($r = -0.29$, $p < 0.01$), but corporate executives showed no significant age-related changes ($r = -0.12$). However, no significant differences were seen in the two groups' correlation coefficients.

As regards to stress, the correlation coefficient between cortisol value and chronological age was $r = 0.16$ for corporate executives and $r = 0.11$ for the Control Group, showing no significant differences between the two groups. However, a test of the correlation coefficient of the DHEA-s/cortisol ratio showed a significant difference ($p < 0.01$) between the two groups, with $r = -0.18$ for executives and $r = -0.50$ for the Control Group. In other words, whereas DHEA-s/cortisol ratios of corporate executives were unaffected by age, those of the Control Group declined with age.

Discussion

Industrial health/hygiene and anti-aging medicine

A number of problems are still seen in Japan's industrial health/hygiene environment that are different from those seen in the US and Europe. These include long working hours, unpaid overtime work, gender inequality, sexual harassment, and long commuting time. Workers become eligible to receive pension payments at the age of 65 in Japan; thus, the age at which the rate of male employment falls below 50% is 67 years, which is extremely high compared with most countries in the West.[6] This calls on the need to cope adequately with the declining physical performance that comes with aging. Industrial physicians must become actively involved to address these issues and resolve them. Since many of industrial physicians' activities are categorized as "prophylactic medicine," knowledge of anti-aging medicine will definitely play an increasingly important role. Healthcare management of corporate executives is another important duty of industrial physicians. Until now, very limited information on the

health status of corporate executives has been available. The findings obtained from our study are expected to be extremely useful for practicing health management of corporate executives.

General tests

Of the general test items, height, weight, blood pressure, sugar metabolism and lipid metabolism showed little or no difference between corporate executives and the controls of the same sex and generation. The only difference seen in liver function was the higher γ-GTP levels of corporate executives. This clearly signifies that corporate executives consume greater amounts of alcohol, and as a result, their hepatic function had declined slightly. It is important, therefore, for corporate executives not only to reduce their daily alcoholic intake, but also refrain from drinking twice a week to give their liver sufficient rest.

This is the extent of information that conventional types of comprehensive physical examinations can provide by way of data analysis and advice to corporate executives. Below are some of the findings newly obtained from the Comprehensive Neurological Examinations Section.

Bone, vascular, and hormone age

In analyzing the age-induced changes in various test results obtained from this study, the following must be taken into consideration: contracts outlining the professional duties of corporate executives are renewed each year and approved at the general shareholders' meeting. Only the contracts of executives who are capable of carrying out their professional duties are approved. This means that the older an executive becomes, the greater their chances of dropping out. Those who remain in executive posts despite old age are survivors in a fiercely competitive environment.

With increasing age, people's bone mass decreases and the bone's minute structure deteriorates. As a result, fractures tend to occur more readily. This condition is known as osteoporosis.[5] The DXA method can be used to measure bone density, and, based on the reference values of bone density of the Japanese population,[7] the degree of bone deterioration can be estimated in terms of bone age. A test of bone age showed that corporate executives had high bone density, and that their bone age was 5.3 years younger than their chronological age. Although a person's bone density is determined genetically, to a certain extent, it is significantly affected by the so-called lifestyle-related factors, such as eating habits, as well as exercise and smoking, which are external or acquired predisposing factors. As far as meal habits are concerned, besides following the basic rule of taking vitamins, minerals and protein from foods, it is important to do exercise that directly stimulates the bone. Our studies showed that corporate executives had significantly higher IGF-I values than the Control Group, pointing to the possibility that growth hormones/IGF-I systems may have positive effects on bone metabolism. [8]

Tests of vascular age showed no significant differences between corporate executives and the Control Group. The age of executives was 59.5±5.6 years, and their vascular age was 58.0±10.4 years, indicating that their vascular age was extremely close to their chronological age. This shows that arteriosclerosis has been progressing as expected for their age, which is by no means a desirable state of affairs. The three leading causes of death in the Japanese are cancer, cerebral apoplexy and heart disease. Except for cancer, they are all associated with arteriosclerosis. Maintaining the cardiovascular system in a young and healthy state is extremely important to prevent cerebral apoplexy and heart disease. Risk factors for arteriosclerosis include smoking, hypertension, diabetes, and high blood cholesterol. Correcting these factors is the basis for preventing arteriosclerosis. Recently, the following new risk factors have been drawing notice: homocystine, high-sensitive CRP, insulin, stress hormones such as cortisol, and oxidative stress markers. As industrial physicians, we wish to propose that corporations incorporate these items in their physical checkups.

In the hormone age test, DHEA-s showed no significant differences between the executives and the Control Group. However, the executives had 15% higher IGF-I values than the Control Group. An analysis of DHEA-s, IGF-I, and age in 465 patients showed that DHEA-s ($r = -0.33$, $p < 0.01$, $Y = -21.7X + 2493$) and IGF-I ($r = -0.47$, $p < 0.01$, $Y = -2.27x + 298.8$) correlated significantly with chronological age [9]. If the IGF-I hormone age is calculated using these regression lines, the executives were 47.5±18.5 years, and the Controls 55.8±16.2 years, showing that the executives were 8.3 years younger than the Controls ($p < 0.01$). By way of reference, no significant differences were seen in DHEA age, with the executives being 53.5±25.5 years, and the controls 51.1±32.1 years.

This DHEA-s, which is secreted from the adrenal gland, is believed to be related to immune strength, resistance to stress, mental activity, sugar metabolism, and bone metabolism. Moreover, male and female hormones, as well as anabolic hormones, are said to be synthesized as a spin-off from DHEA-s.[10-12] Secretion of DHEA decreases with age; however, DHEA replacement therapy has been shown

to improve symptoms that occur because of a relative lack of DHEA, and to help enhance patients' QOL.[13-16]

On the other hand, growth hormone, secreted from the pituitary gland, causes IGF-I to be synthesized in the liver. IGF-I is involved in the maturation, repair, and maintenance of the muscles, bones, and various organs. It is a hormone that has a major effect on a person's mental activity and sexual potency.[8, 17-20]

Both are important hormones for maintaining youthfulness and good health. After a person reaches the age of 30, however, they decrease slowly with age. IGF-I, in particular, is also affected by a person's lifestyle habits, and clearly decreases if there is a lack of exercise, insufficient sleep, stress, obesity, and insufficient protein in their food. Therefore, to maintain one's hormone age at a youthful level, people need to correct their lifestyle habits. Some say that excessive secretion of IGF-I, or administration of growth hormones or their stimulants requires caution, since the higher risk of cancer and other resultant problems have not yet been overcome.[21,22]

Stress

Stress is an essential factor that influences aging and QOL. Although one paper [23] questions the method of evaluating stress by measurement of cortisol levels only, one of the methods for objectively identifying degree of stress is the measurement of stress hormone (cortisol) in the blood.[24]

The results of our study show that executives had high cortisol levels, revealing that they were carrying out their duties under a tremendous burden of stress. It appears that high resistance to stress is an important qualification for corporate executives.

We have already stated that DHEA-s reflects one's resistance to stress. The fact is, however, although this may be proven by animal experiments, it is not easy to prove in humans.[25] Cortisol shows the intensity of stress, while the DHEA-s/cortisol ratio reflects the balance between one's resistance to stress and the intensity of stress. These two need to be appropriately balanced. The DHEA-s/cortisol ratio is not especially high in corporate executives, so the secret to their resistance to stress would appear to lie elsewhere. For example, since IGF-I positively affects the cerebral nervous system, [18] there is a possibility that it plays a role in combating stress.

Common questionnaire on QOL and aging

Results compiled from a common questionnaire on QOL and aging [2, 3] showed that there was a clear difference between corporate executives and members of the control group who belong to the same generation. It was found that corporate executives had favorable scores for a variety of physical and mental symptoms in general. An especially large difference was seen in mental symptoms, with the scores of executives significantly outperforming those of the control in 12 of the total of 21 items. This reflects the their awareness of goals at work, motivation, a sense of achievement, and their enterprising spirit, which are all believed to be secrets of the mental toughness needed to overcome stress. Generally speaking, these scores deteriorate with age and reflect the age of a person's cerebral nervous system. Therefore, we can see that corporate executives maintain a youthful cerebral nervous system. At present, a method for calculating the age of the cerebral nervous system in numerical terms has yet to be established. By accumulating more case studies, we plan to devise a method of evaluation.

Correlation with the chronological age

Next, we investigated how the items for various tests change with age. For example, the correlation coefficient between age and the mental symptom, depressed, was $r = -0.41$ for corporate executives, but $r = -0.03$ for the same-generation controls. This signifies that, with executives, the symptom of "depressed" fades as they grow older; while, with the controls, the symptom showed very little change due to age. Similarly, the older the executive, the milder their "pessimism," and "feeling of anxiety for no special reason" symptoms become. With the controls, in contrast, these symptoms gradually intensify with age. "A significant difference in a test of correlation coefficient" means that age-induced changes seen in corporate executives and same-generation controls were statistically and significantly different.

Corporate employees usually renew their employment contracts once a year. To remain in their posts even after old age, they must overcome a variety of obstacles and actively fulfill their responsibilities. The data shows that to do this, executives must overcome mental weaknesses such as "depressed," "pessimism," and "feeling of anxiety for no special reason."

An analysis was also made of the correlation between the results of the blood tests and chronological age. The results showed a significant difference between corporate executives and same-generation controls in the correlation coefficient related to the DHEA-s/cortisol ratio. The DHEA-s/cortisol ratio shows the balance between a person's resistance to stress and intensity of stress. In other words, although the stress balance changed very little with

age among corporate executives, it worsened with age among the same-generation controls. The contracts for extending the tenure of corporate executives is usually renewable annually, and the number of those who have their contracts approved decrease each year. Therefore, those who remain in their posts as corporate executives for longer periods are in good physical condition and are able to maintain this stress balance. This is required to survive in a tough, competitive environment.

There are a number of reports that discuss aging from the industrial health/hygiene perspective.[26-28] Generally speaking, as people age, they see a reduction in cerebral nervous as well as sensory functions such as visual acuity, sense of balance, and attentiveness; a reduction in motor functions such as agility and endurance; and a reduction in stress resistance and immune strength. These affect work performance in a variety of ways, such as increased morbidity rates for lifestyle-related diseases and chronic diseases, fatigability due to work, increase in work-related blunders, and an increase in the rate of incidence of property damage, accidents, and industrial injuries. Occupational aptitude (adaptability) also narrows with age. More importantly, the gap between healthy people and unhealthy people widens with age. Chronological age no longer becomes meaningful; his or her physiological age becomes more important when considering their suitability of employment.[27, 28] Likewise, the results obtained from our study on corporate executives show that their physiological age is more meaningful than their chronological age as a numerical figure. In considering suitability of employment of executives, it appears that emphasis is being placed on factors that constitute their physiological age, such as bone age, IGF-I hormone age, and stress resistance capabilities. Suitable employment is important, since satisfaction with work leads to enhanced quality of working life.[29] This holds true whether a person is a corporate executive or a general worker.

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