Beneficial Effects of Medical Advice Provided to Elderly Persons under the Anti-Aging Health Check-Up System at Tokai University Tokyo Hospital

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Objective: Tokai University Tokyo Hospital implemented its holistic anti-aging health check-up system in June 2006. This system is characterized by more than 70 check items and the provision of individual post-diagnostic advice of far greater detail than an ordinary health check-up. We analyzed aging-related changes in subjects who had completed their second check-up in order to determine the difference before and after coaching type of medical advice.
Subjects and Methods: Twenty-five recipients of the anti-aging health check-up at Tokai University Tokyo Hospital between June 2006 and April 2008 were included (15 males 10 females, mean age 65.1 ± 9.6 years, average check-up interval 12.5 ± 1.6 months). Based on the results of the first check-up, written advice on issues including diet, exercise, rest (sleep), smoking, alcohol intake, and supplements was provided by nutritionists, supplement advisers, and trainers specializing in Sports Medical Science in Tokai University. Besides this, doctors specializing in anti-aging medicine provided comprehensive coaching. Changes in BMI, abdominal girth at navel level, pressure wave velocity (PWV) and serum levels of total cholesterol (TC), HDL cholesterol (HDL-C), adiponectin (Adi) and free testosterone (in males) were expressed as % basal change and compared in the first and second check-ups.
Results: A year after the coaching, Adi and HDL-C both increased significantly while PWV tended to decrease. However, BMI and abdominal girth were unchanged. DHEA-S showed a rising trend while free testosterone also increased significantly.
Conclusions: These results indicate that the coaching type of medical advice provided in the anti-aging health check-up potentially mitigates aging-related detrimental changes, bringing some benefits to elderly persons.

Key words: Aging, Anti-aging, Coaching, Percent basal change, Adiponectin

BACKGROUND

In June 2006, Tokai University Tokyo Hospital established a holistic anti-aging health check-up system [1–3], the first to be started in Japan by a university medical school. The main purpose of ordinary health check-ups is to identify abnormalities already present in the body. The anti-aging health check-up system arranged by Tokai University differs from this in that it includes more than 70 check items that are not provided by the ordinary health check-up system, and it not only seeks out existing diseases but also provides data for predicting future disease risks and the scale of occurrence.

The most important role of the anti-aging health check-up system, however, is that it provides a wide variety of post-diagnostic advice promoting a self-management type of lifestyle intervention, just like coaching [4], in far greater detail than the ordinary health check-up.

OBJECTIVE

It is known that the progress of arterial sclerosis and decrease in sex hormones are strongly related to aging. However, the effects of coaching-intervention on these aging-related detrimental changes in elderly persons are not widely understood. This study was conducted to determine the beneficial effects of coaching type of medical advices on aging-related detrimental changes in elderly persons provided under the anti-aging health check-up system at Tokai University Tokyo Hospital.

SUBJECTS AND METHODS

1. Subjects

Twenty-five subjects who underwent twice to the anti-aging health check-ups at Tokai University Tokyo Hospital between June 2006 and April 2008 were included. They consisted of 15 males and 10 females, their mean age was 65.1 ± 9.6 y/o (range 44–79 y/o), and the average interval between the first and second check-ups was 12.5 ± 1.6 months. All subjects were non-smokers.

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To determine the changes in various parameters by aging, 329 subjects aged between 40–79 y/o who underwent one health check-up during the same period were analyzed according to gender- and decade-age-specific classification (173 males, 153 females; 40–49 y/o: male 14, female 17; 50–59 y/o: male 49, female 44; 60–69 y/o: male 65, female 53; 70–79 y/o: male 47, female 39). This analysis was performed to assess whether anti-aging type of coaching was able to mitigate aging-related changes in parameters as described below.

2. Contents of medical advice

Coaching is a self-management communication technique to promote self-improvement efforts by the recipients [5]. To produce a more effective outcome, we explained coaching type of medical advice and how it differs from conventional health advice. Benefits from coaching have been reported for various medical conditions such as diabetes [6], hyperlipidemia [7], cancer-related pain [8] and neurodegenerative diseases [5]. These reports concluded that the basis for effectiveness of coaching was the promotion of not only self-management but also adherence to treatment regimens, as well as assistance to patients in effectively interacting with their physicians, negotiating mutually acceptable treatment plans, and attaining a greater sense of self-efficacy.

Based on the results of the first check-up, written advice on issues such as diet, exercise, rest (sleep), smoking, alcohol consumption, supplements, hygiene and stress avoidance was provided by nutritionists, supplement advisers, and trainers specializing in Sorts Medical Science affiliated with the School of Physical Education. The advice was based on a full understanding of the physical individuality of each participant, and was designed to improve abnormal readings and promote health in general. Besides this, doctors specializing in anti-aging medicine provided written evaluations of individual test results, and based on the content of these evaluations and the expert advice mentioned above, held coaching sessions lasting at least 30 minutes in a free dialog format whereby various questions could be answered. Dietary counseling was provided not only on the three major nutrients (carbohydrate, protein and fat) but also on dietary fiber, vitamins and minerals. As for exercise, it was explained that not only energy consumption but also resistance efforts were aimed at increasing muscle mass [9].

3. Subjects for measurement

1) Physical constitution

Changes in physical constitution were measured via body mass index (BMI) and abdominal girth at the navel level in centimeter [10].

2) Estimation of the degree of arterial sclerosis

Levels of arterial sclerosis in blood vessels were estimated by pressure wave velocity (PWV) using a sphygmomanometer (pulse and blood pressure meter: Nippon Kolin PWV/ABI) on both right and left sides [11].

3) Serum biochemical analysis

Total cholesterol (TC), HDL cholesterol (HDL-C) and adiponectin are known to be related to the progress of arterial sclerosis and cardiovascular events [12]. Serum levels of total cholesterol (TC) and HDL cholesterol (HDL-C) were measured via enzyme immune assay (EIA). Adiponectin was measured via ELISA [13].

4) Measurement of serum hormones

Dehydroepiandrosterone sulfate (DHEA-S) is produced by the adrenal gland and is an important base from which other key metabolites are derived. DHEA-S and free testosterone both show clear decreases with aging. DHEA-S was measured using CLEIA in both males and females [14], and free testosterone was measured using RIA in males, and the impact of lifestyle advice on the aging phenomenon was studied [15].

5) Data analysis

The data obtained was expressed in terms of mean ± SD before and after the subjects received coaching type of medical advice.

The apparent normal range of parameters used was BMI < 25, abdominal circumference < 85 cm for men and < 90 cm for women, HDL-C between 40 and 80 mg/dl, and TC between 130 to 220 mg/dl. Normal range of PWV, DHEA-S, and free testosterone was generally appropriate for each age group, and was in the following range (60–69 years old) : PWV 1100 to 1500 cm/sec, DHEA-S 240 to 2440 ng/ml, free testosterone 5.4 to 16.7 pg/nl.

The group that showed a normal distribution was statistically compared using a paired *t*-test; however, it was not examined using a non-parametric Wilcoxon signed-rank test. When comparing two groups using direct data, the problem remains that real differences are difficult to observe due to inherent variation depending on sex and age. To solve this, individual changes were worked out as percent basal change (%BC) and the two groups were compared on this basis. In other words, values before and after the post diagnostic coaching type of medical advice were compared by subtracting the values in the initial diagnosis from those in the second diagnosis, dividing them by the initial values and multiplying this by 100 [16].

Gender- and decade-age-specific classifications were also expressed as mean ± SD. The difference and relationship between age and values in each generation were analyzed by Spearman's test.

6) Informed consent

This study was approved by the Ethical Review Board of Tokai University. Informed consent was obtained prior to conducting the coaching intervention sessions, in compliance with the Declaration of Helsinki.

4. Results

1) Changes in physical constitution

BMI was unchanged at 21.8 ± 2.4 on the first diagnosis and 21.8 ± 2.5 on the second diagnosis (Fig. 1a). In a comparison based on %BC, the result of 1.5 ± 7.4% similarly presented no significant change (Fig. 1b). Gender- and age-specific analysis showed that BMI was

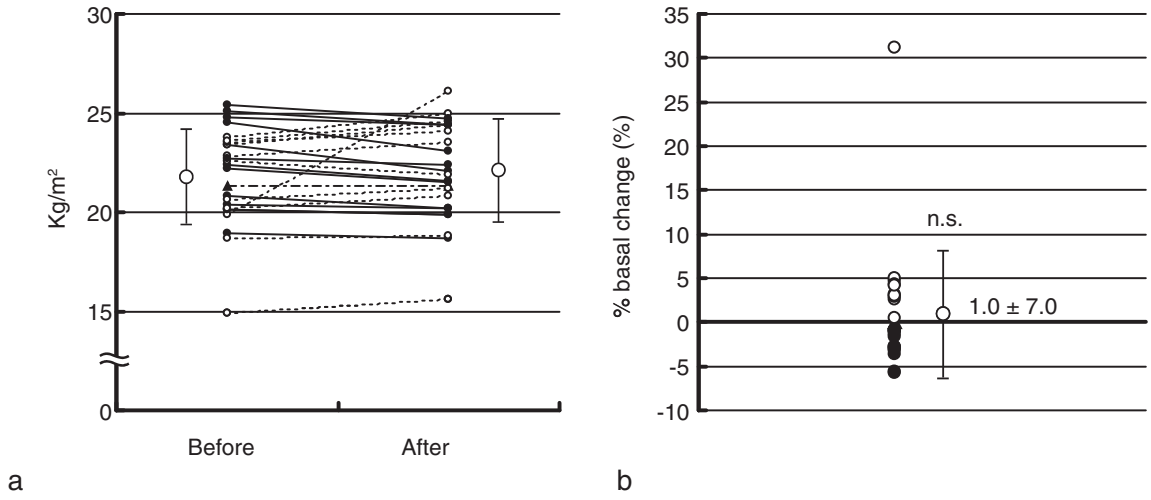

Fig. 1 Changes of BMI after taking of medical advice

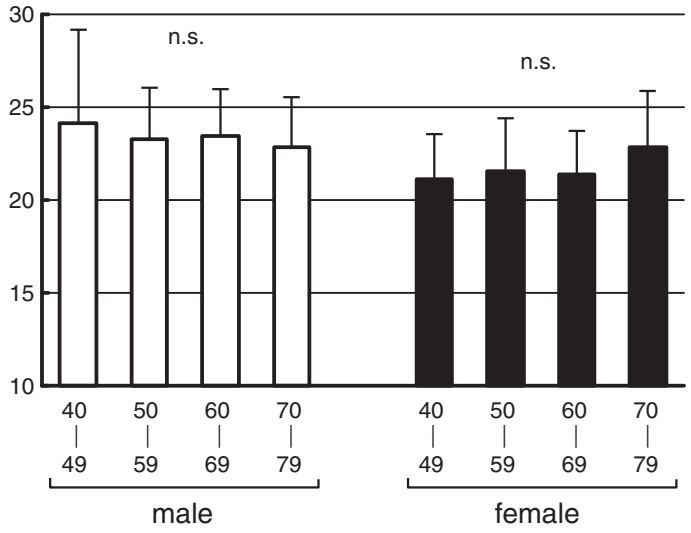

Fig. 2 Gender and age specific BMI

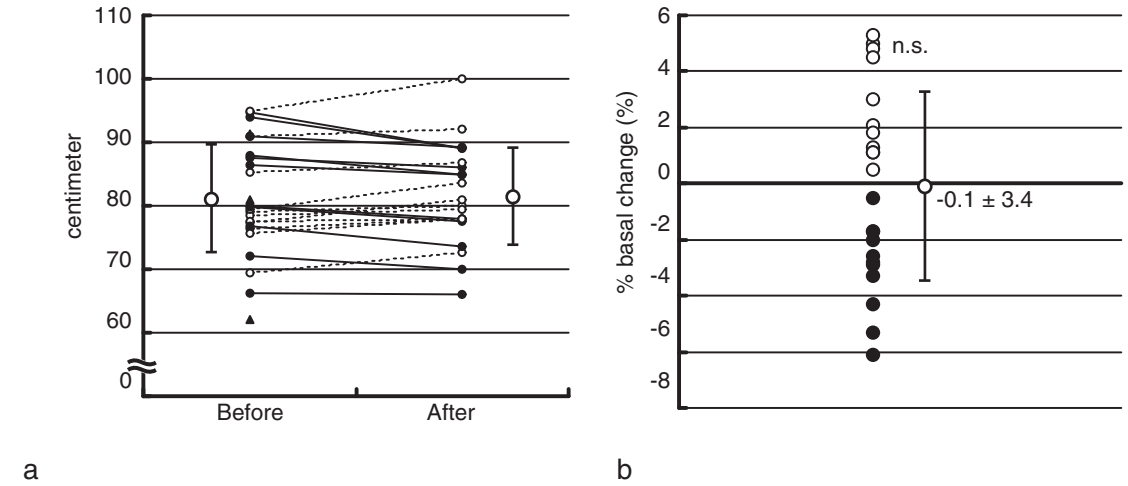

Fig. 3 Abdominal girth after taking of medical advice

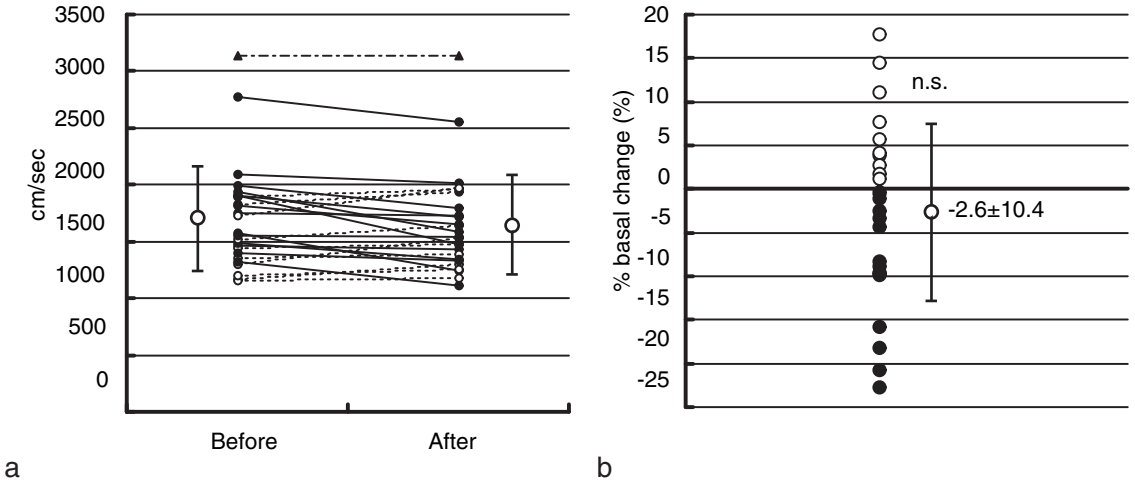

Fig. 4 Changes of ba-PWV (left) after taking of medical advice

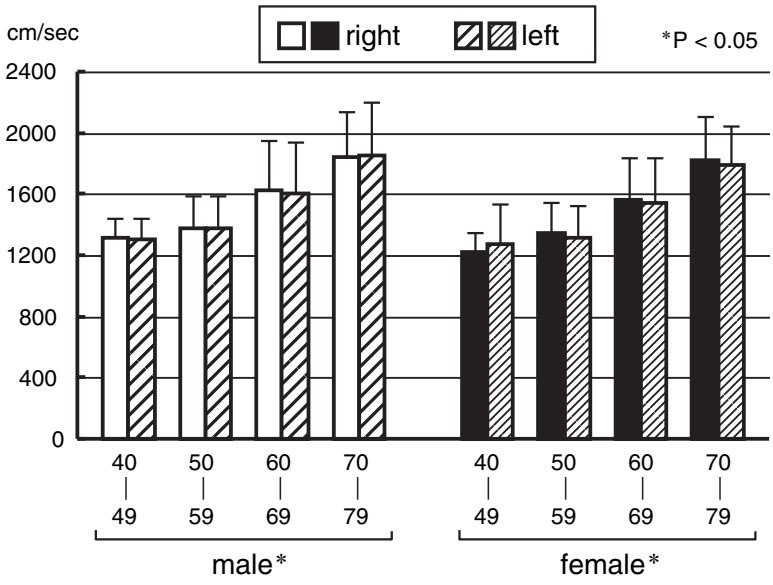

Fig. 5 Gender and age specific baPWV

unchanged (Fig. 2).

No change was seen in abdominal girth either, with 81.4 ± 8.9 on the first diagnosis and 81.7 ± 7.8 on the second diagnosis (Fig. 3a). Comparison based on %BC produced 0.1 ± 3.4%, again showing no change (Fig. 3b).

2) Measurement using sphygmomanometer

Measurement of right-side baPWV revealed no significant difference, with 1692.7 ± 471.1 on the first diagnosis and 1636.5 ± 470.4 on the second diagnosis. Comparison based on %BC, however, revealed a decreasing tendency with –2.5 ± 11.5% in median values ($p = 0.128$). This trend was also seen on the left side, where there was no significant difference, with 1707.7 ± 467.8 on the first diagnosis and 1653.7 ± 479.5 on the second diagnosis (Fig. 4a). Comparison based on %BC revealed a decreasing tendency, with –2.1 ± 10.9% ($p = 0.125$) (Fig. 4b). In the gender- and age-specific analysis, baPWV increased significantly along with age in both males and females. There was no difference between the left and right sides (Fig. 5).

3) Serological analysis

As serum lipids related to arterial sclerosis, TC was unchanged from 205.8 ± 26.1 in the first year to 205.8 ± 26.1 in the second (Fig. 6a). In the comparison based on %BC, there was a slight increasing trend, 3.4 ± 10.6%, although no significant difference was seen (Fig. 6b). However, an increasing trend in HDL cholesterol (HDL-C) was observed, with 54.9 ± 13.4 in the first year and 59.2 ± 15.5 in the second (Fig. 7a), and in the comparison based on %BC, an increase of 8.3 ± 14.8% was observed ($p = 0.010$) (Fig. 7b). In the gender- and age-specific analysis, both the total and HDL cholesterol showed no change with aging (Fig. 8, 9).

Adiponectin showed a consistent significant increase from 10.3 ± 7.0 in the first year to 12.3 ± 10.5 in the second (Fig. 10a), while in the comparison based on %BC, a similar significant rising trend was seen, 14.4 ± 16.8% ($p = 0.0001$) (Fig. 10b). Serum levels of adiponectin showed an age-specific increase in females (Fig. 11).

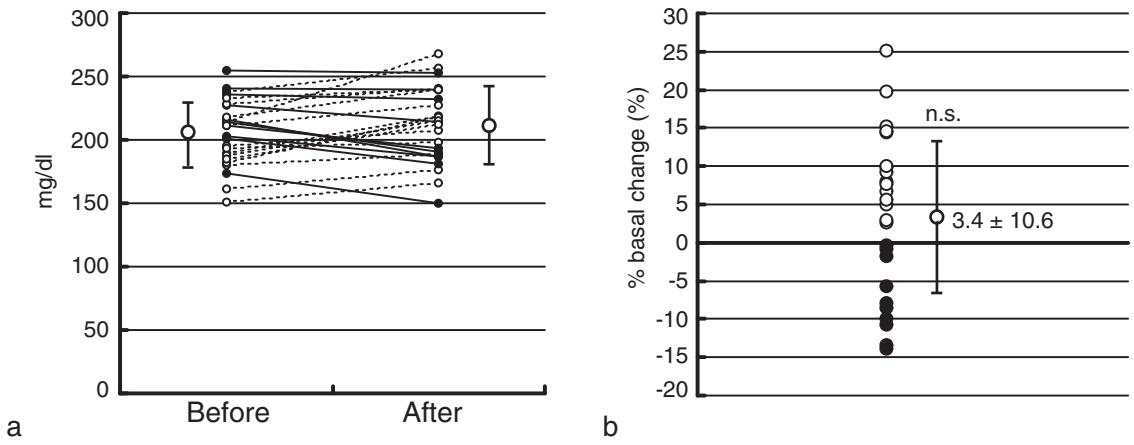

Fig. 6 Changes of total cholesterol after taking of medical advice

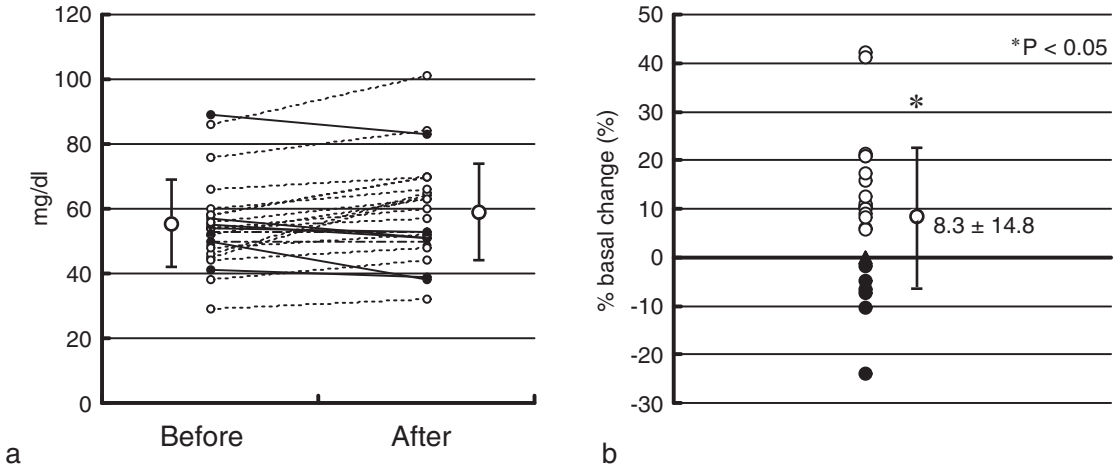

Fig. 7 Changes of HDL- C after taking of medical advice

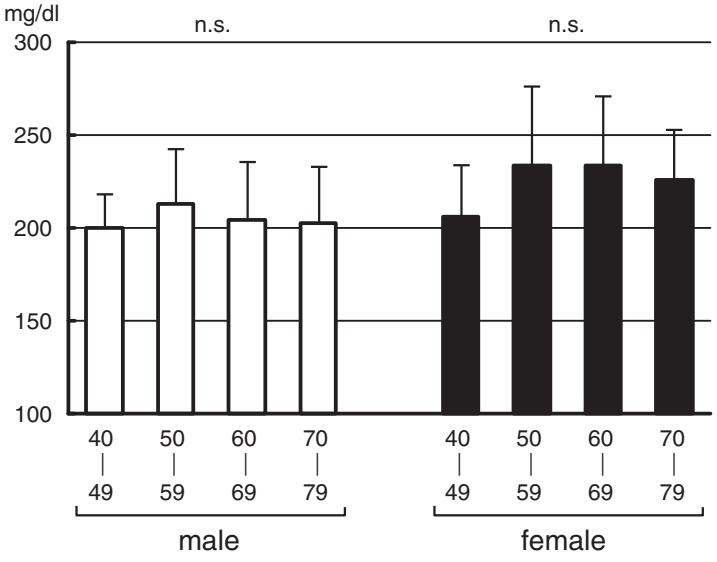

Fig. 8 Gender and age specific total cholesterol

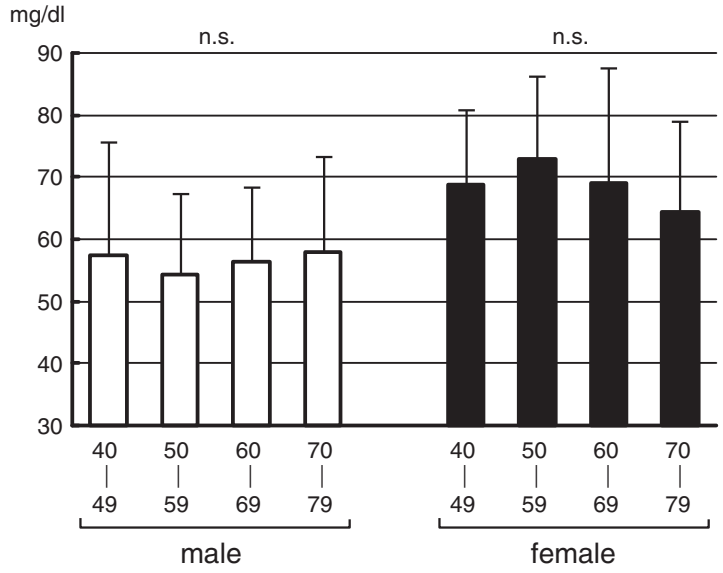

Fig. 9 Gender and age specific HDL-C

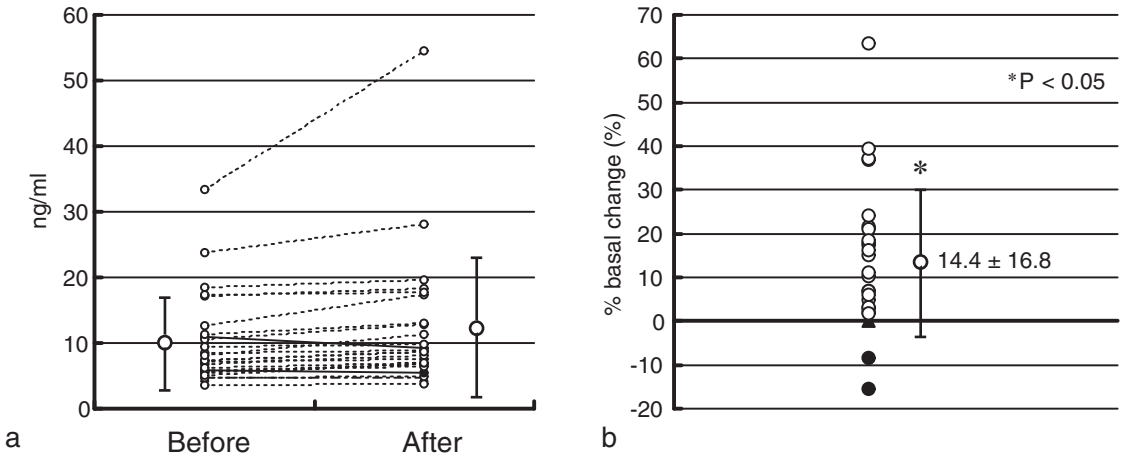

Fig. 10 Changes of serum adiponectin after taking of medical advice

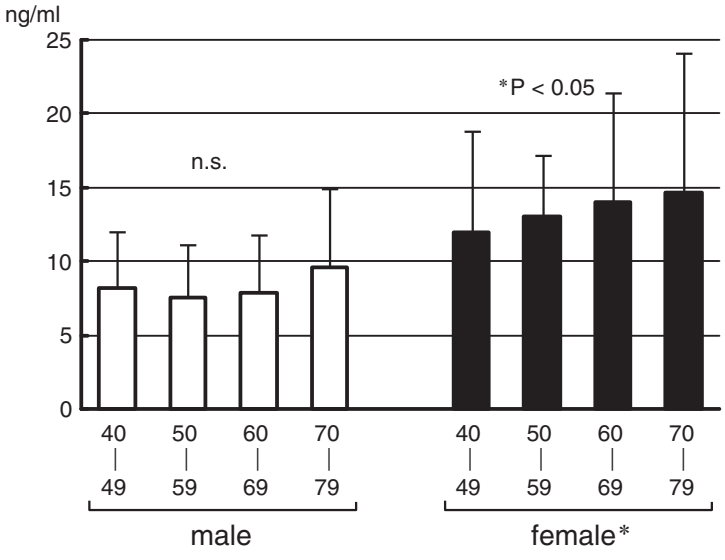

Fig. 11 Age and gender specific adiponectin

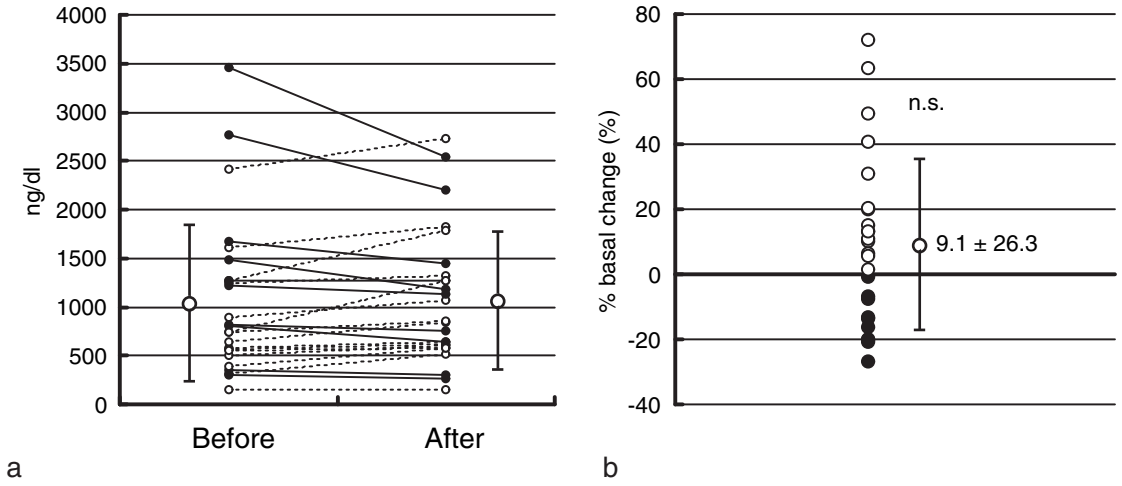

Fig. 12 Changes of DHEA-S after taking of medical advice

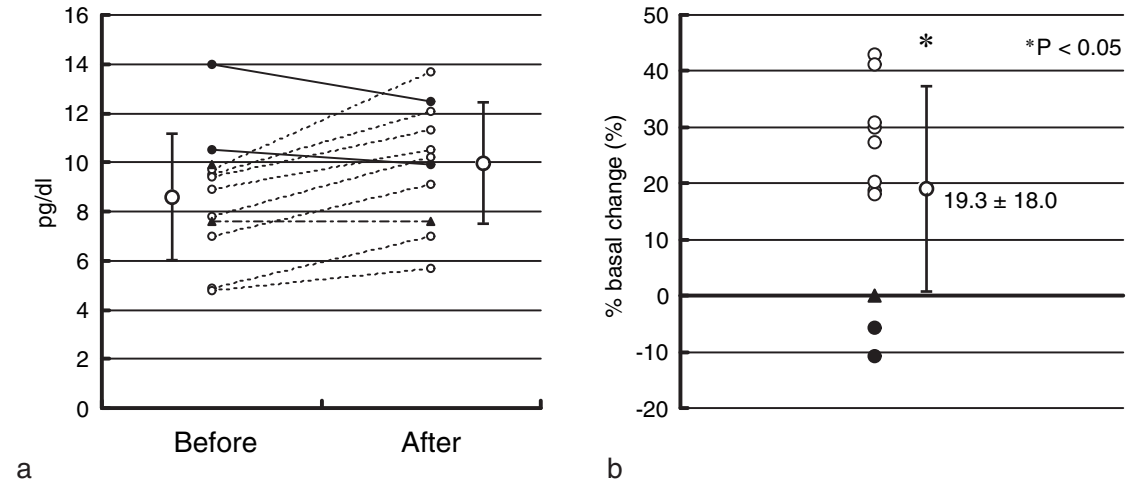

Fig. 13 Changes of free-testosterone after taking of medical advice

4) Measurement of serum hormones

DHEA-S, which undergoes a clear decrease with aging, showed considerable variation, with 1070.3 ± 817.1 in the first year and 1085.1 ± 691.3 in the second (Fig. 12a), revealing an increasing trend but no significant difference. Similarly, in the comparison based on %BC, an increase of 9.1 ± 26.3% was seen with no statistical significance (Fig. 12b). However, 16 of the 25 subjects (64%) showed an increase in DHEA-S.

Meanwhile, the male hormone free testosterone showed an increase from 8.7 ± 2.5 in the first year to 10.0 ± 2.5 in the second (Fig. 13a), while a significant difference of 19.3 ± 18.0 was seen in the comparison based on %BC ($p = 0.015$) (Fig. 13b). In the gender- and age-specific analysis, both total DHEA-S and testosterone decreased significantly with aging (Fig. 14, 15).

5. Discussion

Japanese population is now starting to fall as a result of the low birth rate that reached its nadir in 2004. At the same time, the elderly population is rapidly increasing, with those aged 65 and older accounting for more than 20% of the population [17]. The result of these two trends is a shrinking workforce, rising medical costs, and increased national insurance payments, all of which threaten to weaken the country and break the national insurance system itself. However, if people can remain healthy and active into their golden years, this problem can potentially be delayed or mitigated. Consequently, the government is focusing on preventive medicine. It was against this background that in June 2006 Tokai University established the first anti-aging health check-up system at the Tokai University Tokyo Hospital. This health check-up was developed to utilize our unique position as a university medical school to help Japan address the problems of its aging society. The most important elements in any field of medicine are a scientific foundation and clear evidence. However, in that respect, anti-aging medicine is still in the development stage. Our anti-aging health check-up system includes more than 70 check items that are not provided by the ordinary health check-up system, and it not only seeks out existing diseases but also provides data for predicting future risks. The most important role of the anti-aging

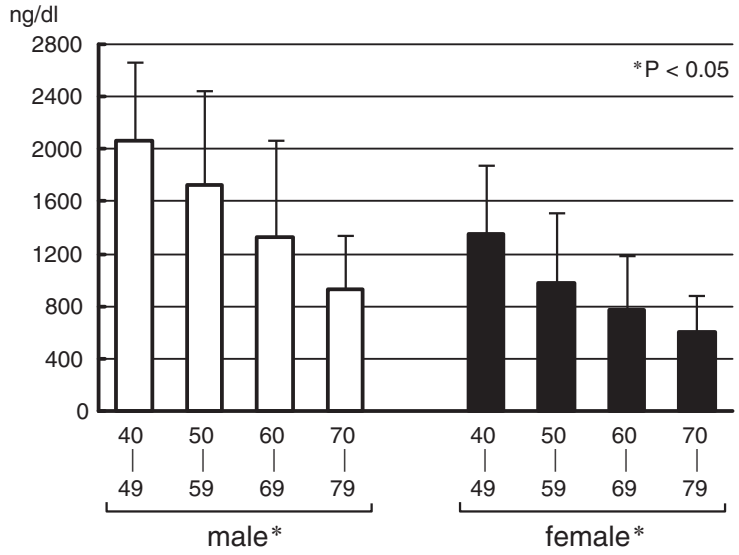

Fig. 14 Age and gender specific DHEA-S

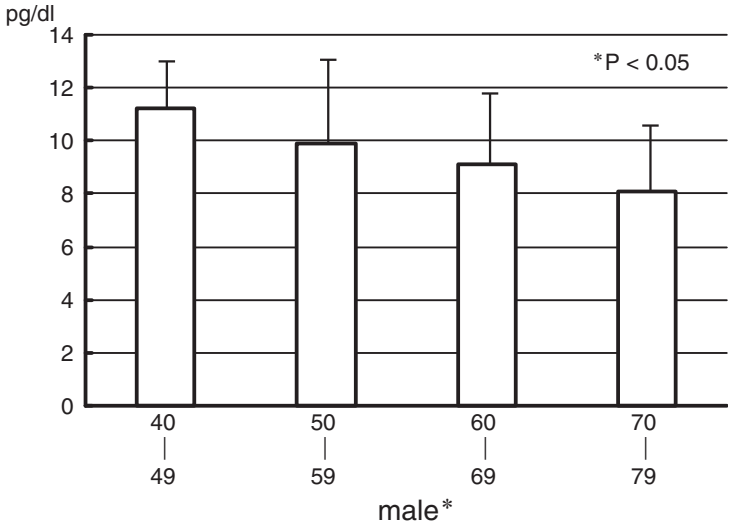

Fig. 15 Gender and age specific testosterone

health check-up system is providing individual medical advice that includes a wide variety of post-diagnostic advices. However, the effects of medical advice on aging-related subjects for elderly persons are not widely understood. Thus, this report is important as it contains the first evidence that adequate coaching type of advice-intervention can improve many of the detrimental changes associated with aging. As of May 17, 2008, we examined 383 people from among the 408 scheduled for participation. Of those that completed examinations, 52% were male and 48% female. At this point, 30 people (8.5% in repeat rate) have completed two examinations, and 1 person has completed three. Since two weeks are needed to gather all the results, our analysis is based on 25 of the 30 people who completed two examinations.

The baPWV index, which reflects vascular stiffness, increases with aging and thereby becomes a predictor of cardiovascular events [18]. The mean results should increase after the group of interest ages by one year. In our study, the mean baPWV (lt) for males in their 60s was 1606 cm/sec and that for males in their 70s was 1853 cm/sec. The percentage of increase in this 10-year period was 15.3%. The increase in a year should be almost 1.5%; instead, however, a decreasing trend was seen in the mean value of baPWV. The coaching type of medical advice appears to have prevented the progress of arterial sclerosis, indicating that adequate health advice and self-management has anti-aging effects.

It is possible that the increase in adiponectin and HDL-C inhibited arteriosclerotic progress, which then prevented the rise of baPWV. In our results, adiponectin increased significantly more than that due to natural changes with aging. Fat cells are stores of energy reserves, and they have become the focus of attention as the organ that secretes adipocytokines such as leptin, adiponectin, TNF-α, resistin, free fatty acid (FFA), and plasminogen activator inhibitor (PAI-1). Hypertrophic fat cells produce a large volume of TNF-α, resistin, and FFA, which increase insulin resistance, while adiponectin and leptin have the effect of reducing insulin

resistance, and patients suffering from obesity or Type-II diabetes are known to have increased insulin resistance due to insufficient production of adiponectin [19]. Kubota et al. performed cuff injury experiments on mice whose adiponectin gene had been deleted, and they found a significant increase in the vascular intima-media ratio in vivo, indicating that adiponectin very likely suppresses arteriosclerosis [20]. In addition, Hirose et al. examined the blood of Japanese people over 100 years of age and found that these centenarians had a significantly higher level of serum adiponectin, indicating a possible connection between adiponectin and longevity [21]. Adiponectin is 20 to 30% higher in women than in men until the age of 60. There is no clear difference between women of different ages, while men have almost the same level until the age of 60, with a tendency to increase after the age of 70 [22]. From a different point of view, this suggests that men who maintain a certain level of adiponectin may live to at least the age of 70. It is significant that, as a result of the coaching we provided, 22 of the 25 subjects had a 14% improvement in the median value of their test results.

TC increased by 3.4% however, HDL-C also increased by 8% as one component of this. HDL-C is known to suppress arteriosclerosis [20]. Mori et al. reported that the degree of insulin resistance and the risk of arteriosclerosis vary depending on whether or not the metabolic syndrome accompanied by a clustering of risk factors has visceral fat accumulation with the decrease of serum adiponectin and HDL-C, strongly suggesting a crucial role for visceral fat accumulation in the metabolic syndrome [23]. In our present study, both BMI and abdominal girth remain unchanged; however, BMI showed a rising trend while abdominal girth showed a decreasing trend. Greater abdominal girth generally indicates excessive visceral fat, but the fact that BMI increased with decreasing abdominal girth indicates an increase in muscle mass. In fact, exercise, especially resistance training, is emphasized foremost in the interviews for the anti-aging health check-up system, and increasing muscle mass through resistance exercise in particular is incorporated as a priority theme. These results could therefore be seen as a consequence of the subjects faithfully acting on this advice. Also, the anti-aging health check-up system had been running for less than two years at the time of analysis. It is possible that subjects who had repeated check-ups during this period had greater health awareness, and followed the advice faithfully or even more rigorously.

Dehydroepiandrosterone (DHEA), an adrenal androgen synthesized in the adrenal cortex, acts as the precursor of estrogen and testosterone. The plasma levels of DHEA and its sulfated form (DHEA-S) decline by approximately 80% between the ages of 25 and 75. In our study, DHEA-S showed a rising tendency ($p = 0.11$) with considerable variation. There was no significance in statistical analysis; however, it is very likely to become statistically significant with a greater number of subjects. In our gender- and age-specific study, DHEA-S and testosterone clearly decreased along with aging; however, recipients of the medical advice at anti-aging health check-up system showed an increase in those values even against the natural decrease. Boudou et al. reported that training decreases abdominal fat deposits, improves muscular mass and affects triglyceride and DHEA levels with an inverse relationship to the decrease in triglycerides and increase in DHEA [24]. Additionally, some research has shown that circulating levels of anabolic hormones such as DHEA-S and IGF-I in older women are related to physical activity, muscle function, and aerobic power [25]. Some recipients answered in their interview that an adequately intense exercise routine was started after the first medical advice of the anti-aging health check-up. It is considered that this had a good influence and contributed to the results. DHEA has also been shown to modulate glucose utilization in humans and animals [26]. The report indicates that other good effects are expected through the rise in DHEA.

In our study, the male hormone free testosterone also increased significantly. Testosterone is an important factor for regulating men's body composition. Conversely, the degree of adiposity relates to the level of blood testosterone. Testosterone supplements for elderly men have caused a decrease in body fat and leptin levels caused by an increase in basal metabolism [27]. Mauras et al. reported that testosterone deficiency in young men is associated with a marked decrease in whole-body protein anabolism, decreased strength, decreased fat oxidation, and increased adiposity. These effects of testosterone deficiency are independent of changes in peripheral GH production and IGF-I concentration, even though IGF-I mRNA concentrations decrease [28]. Hawkins et al. examined the effect of exercise on serum sex hormones in men and the results showed no statistical significance in free testosterone in exercisers versus controls [29]. The cause of this testosterone rise is not clear; however, testosterone is known to inhibit adiponectin secretion from fat cells [30]. Testosterone-induced rise in metabolism likely affected body fat mass and other regulators, followed by changes in other parameters.

The mechanism for these changes will be elucidated in the future. However, they likely occurred in conjunction with each other through various relationships. As this report only concerns 25 subjects who underwent second health check-ups, its validity remains uncertain. Moreover, subjects who go for a second check-up within the same year may be highly motivated types who are keen to receive the coaching type of medical advice. Nevertheless, this analysis involved no bias but included all subjects who went for a second check-up during the second year after the start of anti-aging health check-ups. The analysis was important for scientifically verifying the results of a medical advice and in considering how to proceed in future. Although this was a pilot study, the results suggest that there will be no problem in proceeding in the same style in future. Above all, the results are valuable examples of health advice that mitigated aging-related changes and may provide benefits to elderly persons.

6. Conclusions

As changes that followed the coaching type of medical advice in the anti-aging health check-up system, baPWV tended to decrease while adiponectin

and HDL-C both increased. These results suggest that aging-induced changes were prevented and the progression of arterial sclerosis was delayed. DHEA-S showed a rising trend while free testosterone also rose significantly. The most important role of the anti-aging health check-up is the provision of a wide variety of post-diagnostic health advice. This report may be the first evidence indicating the beneficial effects of the coaching type of medical advice provided to elderly persons under the anti-aging health check-up system.

7. Acknowledgements

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