Effects of a More Active Everyday Lifestyle upon Blood Lipids, HbA1c and Various Fitness Levels in Middle-aged and Elderly Men and Women*

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The purpose of this study is to clarify the effects of a more active everyday lifestyle upon blood lipids,hemoglobin A1c (HbA1c) and various fitness levels. Three hundred and sixty one individuals, 116 men and 245 women, living in Katsuyama City, Fukui Pref., volunteered to be subjects in this study. Among all of the subjects, the data of the 30 men and 76 women who participated in both the pre- and the post-tests were analyzed in this study.

As results of this study, it was found that a more active everyday lifestyle for 5 months, while attending supplementary practical lectures, can improve blood lipids and various fitness levels in middle-aged and elderly individuals even if they do not attempt to maintain a specific exercise regimen.

This study was orally presented at the 16th Japanese and Korean Health Education Symposium and at the 63rd Japanese Conference of Education and Health Science held on August 23, 2015 in Kwansei Gakuin University.

Key Words: Blood Lipids, HbA1c, Various Fitness Levels, the Middle-aged and Elderly

1. Introduction

It has been reported before that exercising at a level maintaining 80% of one's maximal heart rate (max HR), and engaging in such exercise 3 days a week for 10 weeks, is effective in increasing HDL-C in the blood and improving arteriosclerotic indices[(1)(2)]. Similarly, an exercise load at 60% of max HR is often recommended as an appropriate intensity to prevent chronic disease and lifestyle related diseases. Furthermore, such moderate exercise, at 40%-60% of max HR, can be effective in decreasing TC in the blood, even in hyperlipidemia patients[(3)]. Also regular and moderate intensity physical exercise (training), due to its pleiotropic effects, could replace, or at least reduce, the use of anti-diabetic drugs, as well as of other drugs given for the control of cardiovascular risk factors in obese type 2 diabetic patients[(4)]. Also, Ruppar et al.[(5)] concluded that supervised exercise interventions can improve lipid outcomes for healthy adults, with possible greater improvement for obese individuals, and through low-intensity exercise.

The effect of increasing in HDL-C has also been reported in walking 3 days a week for 10 weeks in the water[(6)]. The effects of regular exercise, however, will taper off once the exercise ceases. Ebisu et al.[(7)] found increases in serum phospholipid, percent body fat (%Fat) and the total amount of body fat (Fat), along with decreases in blood aldolase, lean body mass (LBM) and trunk flexion in standing position, due to one and a half months detraining. On the other hand, after one and a half months of retraining following detraining, they reported decreases in serum phospholipid, %Fat and Fat, along with increases in

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blood aldolase, LBM and trunk flexion in standing position.

As a summary, Pate et al.[8] indicated that the most reasonable interpretation of the currently available data is that (1) caloric expenditure and total time of physical activity are associated with reduced cardiovascular disease incidence and mortality; (2) there is a dose-response relationship for this association; (3) regular moderate physical activity provides substantial health benefits; and (4) intermittent bouts of physical activity, as short as 8 to 10 minutes, totaling 30 minutes or more on most days provide beneficial health and fitness effects as Ebisu[1] reported.

These results were found in cases where subjects engaged in chronic exercise under a specific exercise load, for instance, to maintain 60% of max HR during exercise, 3 days a week and so forth. It is not, however, usual to spend one's daily life maintaining a specific exercise load or workout regimen. Moreover, a more active everyday lifestyle is much easier to live with than undertaking a specific exercise load perpertually.

The purpose of this study is, therefore, to clarify the effects of a more active everyday lifestyle upon blood lipids, HbA1c and various fitness levels.

2. Methods

Three hundred and sixty one individuals, 116 men and 245 women, living in Katsuyama City, Fukui Pref., volunteered to be subjects in this study. Informed consent was obtained from all of the subjects by explaining the purposes and methods of this study. The variables of both the pre- and the post-tests in the study determined by blood composition were the following: TC, TG, LDL-C, HDL-C, and HbA1c. Other variables in the study were the following: grip strength, open-eyes foot-balance, sit-ups, trunk flexion in sitting position, %Fat, and toe strength. Toe strength is defined as muscular strength of the lower limbs determined by picking up the knob of the measuring instrument between the first and the second toes. Toe strength was measured in both the right and left feet. All of the pre-tests were done in May, 2014.

Between the pre- and the post-tests the chief researcher gave lectures 3 times on different days to subjects concerning the chronic effects of walking in daily life upon health. Walking events were held 6 times. A fitness instructor gave practical lectures 11 times. Subjects also received lectures with cooking practice 9 times from an administrative dietitian. Practical lessons in underwater exercise were administered 8 times. Lectures on health were given 6 times by medical staff. The post-test was conducted in October, 2014.

Walking for 30 min. a day was scored as one point, and all of the subjects were encouraged to acquire 100 points or more during the 5 months of the study. Among all of the subjects, the data of the 30 men (62.9 ± 3.0 yrs) and 76 women (61.8 ± 1.1 yrs) who participated in both the pre- and the post-tests were analyzed in this study.

The measurements of all variables on fitness, besides toe strength, were taken according to the instructions by the Ministry of Education, Culture, Sports, Science and Technology. Toe strength is defined as the muscular strength of the lower limbs determined by picking up the knob of the measuring instrument between the first and the second toes (Nisshinsangyo Inc., 2015). Toe strength was measured in both right and left feet.

Variables also determined were: TC, HDL-C, LDL-C, TG, and HbA1c in blood composition. TC was determined by using a Determiner-L TC (Kyowa Medex Co., Ltd.). HDL-C was determined by using a MetaboLead HDL-C (Kyowa Medex Co., Ltd.). LDL-C was determined by using a MetaboLead LDL-C (Kyowa Medex Co., Ltd.). TG was determined by using a Determiner-L TG (Kyowa Medex Co., Ltd.). HbA1c was determined by using a Determiner-L HbA1c (Kyowa Medex Co., Ltd.).

The paired t-test was used to analyze all data by the Ekuseru-Toukei 2012, the Social Survey Research Information Co., Ltd.

3. Results and Discussion

Mean and standard deviation values of all variables in all age groups are shown in Tables 1 through 6. The *

and ** indicate the significant difference at 5% and 1% levels of significance, respectively, in all tables. The "n" illustrates the numbers of the subjects who actually completed the measurements in all tables.

One hundred and seventy individuals, 55 men and 115 women, finally achieved 100 points or more. The largest number of individuals who achieved 100 points or more was the elderly (65～74 yrs), with 63.2 % of the elderly achieving 100 points or more. The LDL-C was significantly decreased (119.6 ± 24.2 mg/dℓ to 111.9 ± 32.1 mg/dℓ), and grip strength, sit-ups, toe strength measurements in the right and the left feet were all significantly increased (37.0 ± 5.9 kg to 38.3 ± 6.9 kg in grip strength, 13.4 ± 5.6 times to 15.1 ± 6.5 times in sit-ups, 3.8 ±1.2 kg to 4.5 ± 1.8 kg in toe strength in the right foot, and 3.6 ±1.3 kg to 4.2 ± 1.6 kg in toe strength in the left foot) in middle-aged and elderly men (50 yrs or older). The LDL-C was also significantly decreased (117.7 ± 30.4 mg/dℓ through 110.8 ± 30.1 mg/dℓ), and sit-ups, and toe strength measurements in the right and the left feet were significantly increased (7.7 ± 5.5 times to 8.3 ± 6.2 times in sit-ups, 3.0 ±1.0 kg to 3.9 ± 1.2 kg in toe strength values in the right foot, and 3.1 ±1.0 kg to 3.8 ± 1.1 kg in toe strength values in the left foot) in middle-aged and elderly women (50 yrs or older).

Table 1 Variables in the middle-aged and elderly men (50 yrs or older)

Variables	n	Pre-test	Post-test	t
TC (mg/dl)	30	199.9 ± 29.1	191.1 ± 45.9	1.680
LDL-C (mg/dl)	30	119.6 ± 24.2	111.9 ± 32.1	2.448*
HDL-C (mg/dl)	30	60.7 ± 17.9	57.2 ± 20.6	1.401
AI	30	2.6 ± 1.3	2.6 ± 1.3	0.374
LH Ratio	30	2.2 ± 1.0	2.1 ± 1.0	1.269
TG (mg/dl)	30	158.6 ± 101.9	139.3 ± 80.3	1.462
HbA1c (%)	30	6.0 ± 0.8	5.6 ± 1.2	1.384
Grip Strength (kg)	30	37.0 ± 5.9	38.3 ± 6.9	1.731*
Open-eye F. B. (sec)	30	100.1 ± 37.3	99.8 ± 35.4	0.099
Sit-ups (time)	28	13.4 ± 5.6	15.1 ± 6.5	3.224**
Trunk Flexion, S. P.(cm)	29	38.6 ± 13.4	36.5 ± 12.2	1.265
Toe Strength [R] (kg)	30	3.8 ± 1.2	4.5 ± 1.8	3.221**
Toe Strength [L] (kg)	30	3.6 ± 1.3	4.2 ± 1.6	3.141**

(* $p<0.05$, ** $p<0.01$)

where: TC = Total Cholesterol
LDL-C = Low Density Lipoprotein Cholesterol
HDL-C = High Density Lipoprotein Cholesterol
Arteriosclerotic Index (AI) = (TC − HDL-C)/HDL-C
LH Ratio = LDL-C/HDL-C
TG = Triglyceride
HbA1C = Hemoglobin A1C
Open-eye F. B. = Open-eyes Foot-balance
Trunk Flexion, S. P. = Trunk Flexion in Sitting Position
Toe Strength [R] = Toe Strength [Right]
Toe Strength [L] = Toe Strength [Left]

As a result of the analysis, TC and LDL-C were found to be significantly decreased and sit-ups and toe strength values in the right and left feet were significantly increased in the elderly men (65 yrs or older). The LDL-C was significantly decreased and toe strength values in the right and left feet were significantly increased in the elderly women (65 yrs or older).

The sit-ups showed significant increase in the middle-aged men and women (50～64 yrs). Toe strength values in the right and left feet also showed significant increase in the middle-aged men and women (50～64 yrs). Changes in this study are similar in all age groups as shown in other tables.

In general, having superior leg muscular strength is thought to prevent middle-aged and elderly individuals

from falling down. Falling down might cause fracture of the femoral neck in middle-aged and elderly individuals. That possibly causes them to become bedridden and finally develop dementia[9]. Chronic exercise such as a more

Table 2 All variables in the middle-aged and elderly women (50 yrs or older)

Variables	n	Pre-test	Post-test	t
TC (mg/dl)	76	205.3 ± 35.4	202.0 ± 40.4	0.823
LDL-C (mg/dl)	76	117.7 ± 30.4	110.8 ± 30.1	2.265*
HDL-C (mg/dl)	76	71.6 ± 17.2	71.8 ± 18.9	0.125
AI	76	2.0 ± 0.8	1.9 ± 0.8	1.065
LH Ratio	76	1.7 ± 0.6	1.6 ± 0.6	2.191*
TG (mg/dl)	76	121.0 ± 56.9	118.8 ± 58.4	0.305
HbA1c (%)	76	5.7 ± 0.5	5.6 ± 0.9	1.393
Grip Strength (kg)	73	25.0 ± 3.6	23.4 ± 5.5	1.105
Open-eye F. B. (sec)	75	97.8 ± 33.7	97.5 ± 33.9	0.077
Sit-ups (time)	72	7.7 ± 5.5	8.3 ± 6.2	1.739*
Trunk Flexion, S. P.(cm)	74	41.1 ± 10.2	41.4 ± 8.5	0.239
Toe Strength [R] (kg)	76	3.0 ± 1.0	3.9 ± 1.2	7.845**
Toe Strength [L] (kg)	76	3.1 ± 1.0	3.8 ± 1.1	7.629**

(* $p<0.05$, ** $p<0.01$)

Table 3 All variables in the elderly men (65 yrs or older)

Variables	n	Pre-test	Post-test	t
TC (mg/dl)	22	201.1 ± 29.1	188.7 ± 52.1	1.797*
LDL-C (mg/dl)	22	120.5 ± 24.8	111.5 ± 35.9	2.218*
HDL-C (mg/dl)	22	61.3 ± 18.8	56.5 ± 21.1	1.473
AI	22	2.6 ± 1.3	2.5 ± 1.4	0.925
LH Ratio	22	2.2 ± 1.0	2.1 ± 1.1	1.423
TG (mg/dl)	22	153.7 ± 98.3	131.8 ± 75.5	1.468
HbA1c (%)	22	5.9 ± 0.8	5.5 ± 1.4	1.271
Grip Strength (kg)	22	34.9 ± 4.6	35.8 ± 4.8	0.963
Open-eye F. B. (sec)	22	96.2 ± 41.8	95.1 ± 39.6	0.319
Sit-ups (time)	21	13.1 ± 5.8	14.6 ± 7.1	2.326*
Trunk Flexion, S. P.(cm)	21	37.6 ± 14.6	35.0 ± 12.5	1.267
Toe Strength [R] (kg)	22	3.8 ± 1.4	4.5 ± 1.8	3.238**
Toe Strength [L] (kg)	22	3.7 ± 1.5	4.3 ± 1.8	3.026**

(* $p<0.05$, ** $p<0.01$)

active everyday lifestyle, therefore, might prevent becoming bedridden and developing dementia in the future. Since muscle mass is indicated to be atrophied in elderly individuals[10], they might need to through active everyday lifestyle to prevent the atrophy.

Improving toe strength, blood lipids and HbA1c values by a more active everyday lifestyle, as found in this study, is considered to be effective for middle-aged and elderly women individuals since skeletal age and the ages of blood vessels, muscles, nerves and hormones have also been identified as indicators of aging[11]. Especially, a more active everyday lifestyle is comparable to low intensity training. According to the belief that low intensity training, which is easier and safer, can be recommended to a wide variety of people, including older people, to promote health[12], it could be said that a more active everyday lifestyle can be effective for maintaining and promoting health in middle-aged and elderly individuals.

Table 4 All variables in the elderly women (65 yrs or older)

Variables	n	Pre-test	Post-test	t
TC (mg/dl)	36	204.1 ± 33.7	195.6 ± 47.1	1.251
LDL-C (mg/dl)	36	117.7 ± 29.5	106.6 ± 32.0	2.344*
HDL-C (mg/dl)	36	68.6 ± 17.7	66.9 ± 20.0	1.063
AI	36	2.1 ± 0.9	2.1 ± 0.8	0.336
LH Ratio	36	1.8 ± 0.7	1.7 ± 0.6	2.164*
TG (mg/dl)	36	134.2 ± 59.2	136.1 ± 66.5	0.158
HbA1c (%)	36	5.8 ± 0.3	5.5 ± 1.0	1.505
Grip Strength (kg)	36	24.4 ± 3.8	22.4 ± 6.9	1.221
Open-eye F. B. (sec)	36	92.5 ± 34.8	89.1 ± 38.4	0.681
Sit-ups (time)	35	6.6 ± 4.6	7.1 ± 5.6	0.837
Trunk Flexion, S. P.(cm)	36	41.6 ± 10.9	41.5 ± 8.7	0.019
Toe Strength [R] (kg)	37	3.1 ± 1.1	3.9 ± 1.3	4.578**
Toe Strength [L] (kg)	37	3.0 ± 0.9	3.8 ± 1.1	5.643**

(* $p<0.05$, ** $p<0.01$)

Table 5 All variables in the middle-aged men (50 ～ 64 yrs)

Variables	n	Pre-test	Post-test	t
TC (mg/dl)	8	196.8 ± 30.8	197.8 ± 22.8	0.239
LDL-C (mg/dl)	8	117.0 ± 23.8	112.9 ± 19.7	1.050
HDL-C (mg/dl)	8	59.0 ± 16.4	59.0 ± 20.5	0.000
AI	8	2.6 ± 1.1	2.7 ± 1.3	1.253
LH Ratio	8	2.1 ± 0.8	2.2 ± 0.9	0.461
TG (mg/dl)	8	172.0 ± 117.4	159.8 ± 94.4	0.416
HbA1c (%)	8	6.1 ± 0.6	6.0 ± 0.6	3.055**
Grip Strength (kg)	8	42.6 ± 5.8	45.3 ± 7.0	1.700
Open-eye F. B. (sec)	8	111.0 ± 18.3	112.8 ± 14.4	0.241
Sit-ups (time)	7	14.3 ± 5.4	16.7 ± 4.2	2.497*
Trunk Flexion, S. P.(cm)	8	41.0 ± 10.1	40.5 ± 11.4	0.224
Toe Strength [R] (kg)	8	3.6 ± 0.5	4.2 ± 1.6	1.123
Toe Strength [L] (kg)	8	3.5 ± 0.8	3.9 ± 0.8	1.022

(* $p<0.05$, ** $p<0.01$)

Table 6 All variables in the middle-aged women (50 ～ 64 yrs)

Variables	n	Pre-test	Post-test	t
TC (mg/dl)	39	208.7 ± 34.5	208.7 ± 32.7	0.000
LDL-C (mg/dl)	39	119.3 ± 30.3	114.9 ± 28.6	1.184
HDL-C (mg/dl)	39	75.2 ± 15.6	76.9 ± 16.4	1.224
AI	39	1.8 ± 0.6	1.8 ± 0.6	0.925
LH Ratio	39	1.6 ± 0.5	1.6 ± 0.5	2.057*
TG (mg/dl)	39	110.2 ± 53.2	102.3 ± 45.7	0.876
HbA1c (%)	39	5.7 ± 0.6	5.7 ± 0.8	0.121
Grip Strength (kg)	36	25.7 ± 3.2	24.5 ± 3.3	1.137
Open-eye F. B. (sec)	38	104.1 ± 31.4	106.5 ± 26.6	0.701
Sit-ups (time)	36	9.0 ± 6.1	9.7 ± 6.6	1.837*
Trunk Flexion, S. P.(cm)	37	40.9 ± 9.7	41.6 ± 8.3	0.455
Toe Strength [R] (kg)	38	2.9 ± 1.0	3.9 ± 1.2	6.615**
Toe Strength [L] (kg)	38	3.1 ± 1.1	3.8 ± 1.2	5.050**

(* $p<0.05$, ** $p<0.01$)

Since serum cholesterol increased by saturated fatty acid is almost restricted to LDL-C[13], dietary habits should have been analyzed in this study. Extreme decrease in physical activity due to mechanization and the popularization of automobile in society, however, causes ischemic heart disease to spread[14]. Adams et al.[15] furthermore, indicated that many individuals with elevated blood cholesterol will be able to achieve the goal of lowering their cholesterol with dietary, physical activity, or weight reduction intervention. They also stated that physical activity is very important for the management of blood cholesterol.

These results, therefore, seem to indicate that a more active everyday lifestyle for 5 months, while attending supplementary practical lectures, can improve blood lipids and various fitness levels in middle-aged and elderly individuals even if they do not attempt to maintain a specific exercise regimen.

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