

**Electrophysiological Research of the Dynamics
of Ki Energy Using the AMI Device:**

**Effect of Alteration and Interaction of
Ki Energy between the Practitioners
during Aikido's Kokyu-ho**

Koji Tsuchiya, Ph.D.

California Institute for Human Science

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Abstract

Objectives

The purpose of this study is to investigate how the ki energy works in and around our body when practicing an Aikido technique, with two practitioners working together.

Methods

Before and after the technique called “kokyu-ho,” Aikido practitioners were measured on their specific acupuncture points, belonging to the meridians, with the AMI device utilizing the Single Square Voltage Pulse (SSVP) method. The BP values (Before Polarization; the pre-polarization resistance of the skin), related to ki energy, were picked-out of the data and analyzed statistically to determine whether the ki energy changed during the Aikido technique.

Results

- 1) The BP values increased significantly after kokyu-ho;
- 2) The change of the BP values showed a significant difference among 14 meridians after kokyu-ho;
- 3) The difference of the BP values between the left and right side meridians reduced after kokyu-ho;
- 4) The correlation coefficient between partners in a pair, regarding the BP values, showed a significant increase after kokyu-ho.

Conclusions

This study demonstrated that ki energy in the body was activated and balanced by the Aikido technique, and that ki energy resonated between the partners, which suggests the “*Aiki*” phenomenon.

1. Introduction

The subject of this study is the working of ki energy during Aikido practices. Examining the ki energy of Aikido practitioners is a significant way to research the human subtle energy. Recently, the ki energy has been investigated by developing scientific devices and many results of the study were reported (Motoyama, 1986, 1991; Sancier, 1991; Lu, 1997; Korotkov, 2002). Although the topic of ki energy can be regarded as quite new in the Western world, scientific experimental method has enabled us to measure and detect this subtle energy flowing in or emitted from our body (Alvino, 1996; Kido, 1997; Gerber, 2001; Moyer, 2002; Chen, 2004).

This study attempts to investigate how ki energy works in and around our body while practicing an Aikido technique, by means of using Single Square Voltage Pulse (SSVP) method invented by Dr. Hiroshi Motoyama, the president of the California Institute for Human Science. Thus, the purpose of the present study is to examine how ki energy of subjects works by means of Aikido kokyu-ho. In order to verify the ki phenomena, the following research was conducted: subjects are measured at seiketsu (described in later section) with the AMI device before and after the kokyu-ho; the BP values, related to ki energy, were picked-out of the data and analyzed statistically to determine how the ki energy changed during the Aikido technique. The following are the main study areas:

- 1) Change of ki energy by means of kokyu-ho;
- 2) Different change of ki energy among meridians;
- 3) Balance of ki energy between left and right side of the body;
- 4) Mutual influence of ki energy between partners.

Aikido

Aikido is a Japanese martial art, which was developed in modern times, and is spreading worldwide. Aikido has no competition, but aims at harmony with an opponent through ki energy. The “ki” in Japanese, or “qi” in Chinese, is recognized in the East as a human subtle energy similar to a vital power and a life source. In the context of Traditional Chinese Medicine (TCM), it is believed that ki is a fundamental constitution of the body and that the flow of ki maintains the overall health of our body (Wiseman and Ellis, 1996). Aikido techniques are practiced by the virtue of the subtle workings of ki energy rather than muscle power. Through effective training, the ki energy might expand and extend through out the whole body, and interacting between the partners. Accordingly, Aikido practices have the materials for experimentation with which to investigate human subtle energy.

One of the purposes of training in Aikido is that the self ascends to a higher state of mind at which it is no longer one’s self, but is the self which harmonizes and accommodates others; it becomes oneness even with nature and the universe (Ueshiba, 1992). Therefore, Aikido training makes the practitioners reach a state in which oneself and the other are a oneness through harmonizing with each other.

The practitioners might relate to each other through accommodating the ki energy shared between one and the other. Uniting of one’s ki with others is called “Aiki” (Ueshiba, 1993). The “Aiki” designates making one’s ki in tune with that of an opponent (Ueshiba, 1984). Thus, to unite with the partner’s movement through Aikido practices leads to the unification of the partner’s ki. Hino (2004), a master of Japanese martial arts, explains “Aiki” as a mutual influence between two practitioners in the pair, which is a sympathetic movement each other with unconscious.

2. Experimental Method

2.1 Research Design

In order to examine the change of the energy, the subjects are measured before and after the practice of kokyu-ho by using the AMI. Then, BP values related to ki energy are picked-out of the data and analyzed statistically to determine whether the ki energy has changed during the Aikido technique.

There are four main examinations: 1) change of ki energy by means of kokyu-ho; 2) different change of ki energy among 14 meridians; 3) balance of ki energy between left and right side of the body; 4) mutual influence of ki energy between partners. The investigation is to verify that the ki energy in the body is activated and balanced by the Aikido technique, and that ki energy resonates between the practitioners, which is evidently “Aiki” phenomenon.

2.2 An Aikido Technique, “Kokyu-ho”

All Aikido technique is performed by one pair, which consists of “uke” and “nage.” The uke is a receiver who receives techniques, while the nage is a thrower who performs techniques. Kokyu-ho is practiced in *seiza*, which is sitting formally on the knees. As uke firmly grasps nage’s wrists and provides resistance, nage receives the energy that uke gives nage and returns it through uke’s center of balance with a movement of throwing sideward. This practice is repeated with switching the role of uke and nage.

In kokyu-ho, it is essential to use not muscle power but ki energy from the center of the body and to unify with the partner (Gleason, 1995). All parts of the nage’s body must act in unity. Nage must meet uke’s energy extended, with nage’s arms acting like a spring, so that nage can recoil and again extend. Nage’s mind must remain

flexible and receptive (Saotome, 1989). Therefore, kokyu-ho is a kneeling exercise to help develop connection, both physical and ki level, with the partner.

In this study, this Kokyu-ho was chosen out of many Aikido techniques as material for researching ki energy because of the following reasons: 1) to feel ki extending from the center of the body; 2) to use as little physical strength as possible; 3) to be a simple and the most basic training.

2.3 Measuring instrument ---- AMI (Apparatus for Measuring the Functioning of the Meridians and their Corresponding Internal Organs)

The AMI, invented by Dr. Motoyama, measures the electrical conductivity, capacitance, and polarization of skin tissue and fluids at the tip of fingers and toes, called “Seiketsu” in Japanese. The Single Square Voltage Pulse (SSVP) method is an electrical measurement technique detecting the human subtle energy. The technique actually measures a skin impedance by applying a square-wave voltage pulse in microseconds. The AMI device utilizing the SSVP method works by monitoring the electrical conductivity and capacity at specific acupoints at the Seiketsu. The results of measurements evaluate the tissue condition, the functioning of the meridians and their corresponding internal organs (Motoyama, 1996).

The biophysically important parameters proposed by Dr. Motoyama are the **BP**, **AP**, and **IQ** currents. The **BP** stands for before polarization current, which is the peak electrical current, indicating electrical conductivity of the measured system and reflecting information on the meridian system. The **AP** means after polarization current and represents a steady electrical current, which continues to flow even after polarization at the barrier membrane in the skin. There is evidence suggesting that AP is related to the autonomic nervous system (Motoyama, 1996; Kuramoto, et al.1997).

The **IQ** is a parameter that represents the total amount of the electrical charges of the ions accumulated on either sides of the barrier membrane in the skin.

Motoyama (1978) showed that there is a close correlation between the electrical conductivity of meridians, which is determined by BP current, and the flow of ki in the meridians. According to Dr. Motoyama, ki energy is referred as a form of biophysical energy leading to the production of electrical potential, BP current, in the body. Consequently, the BP current was focused as the flow of ki energy in this study.

2.4 Experiment

For the control measurement, in the preliminary AMI analysis, the subjects relaxed by sitting on a chair for 10 minutes. This allowed the researcher to compare any changes fostered by the Aikido technique. An alcohol swab was used to clean the subjects' skin before applying the electrodes.

Next, each 10 mm-diameter ground electrode, masked by 36 mm-diameter adhesive patches, were attached to the subjects' left and right forearms, at approximately two inches from each wrist. Active electrodes with dimensions of 7×7 mm were attached to the 28 seiketsu. The 28 seiketsu (right – left seiketsu of 14 meridians) lie along the nail beds of the fingers and toes. The experimenter touched the seiketsu with the pen-type electrode so that it detected the current in the skin.

After removing all electrodes, the paired subjects practiced kokyu-ho for 10 minutes. During this time period, the paired partners switched between the *nage* and *uke* roles several times.

Finally, after the complete kokyu-ho practice, and then relaxing for 10 minutes, the grounding electrodes and active electrodes were attached as aforementioned. AMI

measurements were carried-out again with the subjects. Thus, the effect of the kokyu-ho was examined for each pair.

2.5 Subjects

For this study, Aikido practitioners were recruited at the Aikido dojo in San Diego and Sacramento, California. The following people were excluded from the subjects: people with acute and chronic illness; the injured; children under 12 years old.

Seventy-three Aikido practitioners (45 male and 28 female) applied as subjects. The range of the age was between 13 and 53. The subjects were categorized depending on ranks such as 33 Black belts and 40 white belts including 8 Beginners, as discussed next.

Ranking demonstrations are held periodically throughout the year and well-executed performances of the arts become the criteria for promotion. Black belts who have trained more than four years can perform advanced techniques with not only physical strength but also ki flow. White belts who have trained less than four years can perform basic and intermediate techniques. Within white belts, the people practicing less than six months were categorized as “Beginners.”

2.6 Data Analyses

Based upon the aforementioned research design, data was collected from the computer connected with the AMI. Then in order to verify a significant change on the BP value, the statistical analyses were processed by utilizing statistical programs. Basically, the **two-tailed paired t-test**, **Chi-square test**, **analysis of variance** and **correlation coefficient** were utilized in data analyses. In addition, to protect the

confidentiality of each subject, in all tables and figures, the subjects' initial were used, as well as assigned pair numbers.

The followings are the analysis methods for each data obtained from the measurements:

2.6.1 t-test

- ✧ The Two-tailed paired t-test was performed to determine whether there is a significant difference for the following cases:

The mean BP values for all subjects between pre- and post- kokyu-ho,

The comparison between categories, such as male/female, and black-belts/white-belts.

- ✧ The mean of the difference of the BP values between the left and right side of the 14 meridians were calculated for all subjects. The t-test was performed to examine whether there is a significant difference between the pre- and post- kokyu-ho regarding the difference of the left and right side of the meridians in the BP values.

2.6.2 Bar graphs

- ✧ The changes of the BP values between pre- and post- kokyu-ho were calculated in each meridian and presented in bar graphs for the categories, such as males/females and black-belts/white-belts.

2.6.3 One-factor analysis of variance>

- ✧ The one-factor analysis of variance was performed in order to investigate a significant difference in the change of the BP values after kokyu-ho among the 14 meridians.

2.6.4 Chi-square test

- ◇ The Chi-square test was performed in order to investigate whether there is a significant difference between the categories regarding the change of the BP values.

2.6.5 Scatter diagram

- ◇ The relationship between the partners' BP values in the 14 meridians was observed by using a scatter diagram.

2.6.6 Correlation analyses

- ◇ The correlation coefficient was calculated by the Pearson Product-Moment Correlation method, if the data showed a normal distribution. The Spearman's Rank Order Correlation method was used, If there was no normal distribution.

3. Results

3.1 Change of ki energy

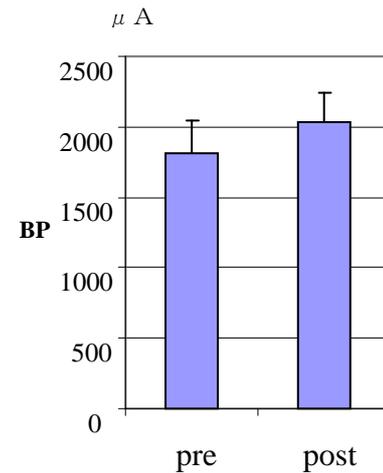
The Two-tailed paired t-test was performed to determine whether there is a significant difference for the following cases:

- 1) The mean BP values for all subjects between pre- and post- kokyu-ho; and
- 2) The comparison between categories, such as male/female, and black-belts/white-belts.

The result of the t-test for all subjects shows the significant difference of the BP values for the meridians between pre- and post- kokyu-ho. The fact that the mean of the BP value of the post-kokyu-ho was higher than that of the pre-kokyu-ho indicates the BP value for the meridians increased after kokyu-ho practice. To the contrary, the standard deviation was reduced after kokyu-ho.

All subjects

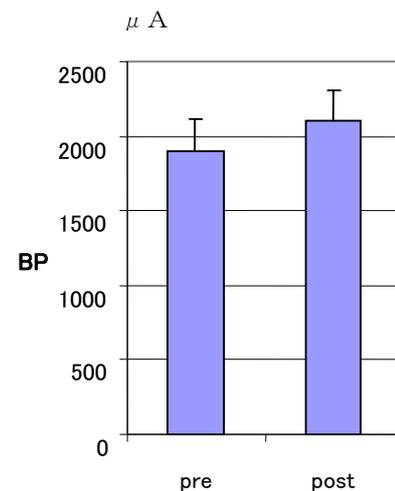
t-test			
All subjects			$\alpha=0.01$
	pre-kokyuhō	post-kokyuhō	difference
Mean	1809.23	2032.77	223.54
SD	242.2	210.2	-32
Observations	73	73	
t Stat	-15.5379		
P(T<=t) two-tail	1.07E-24		
t Critical two-tail	2.645852		



For both males and female, there was the significant difference ($p < 0.01$, 0.001) of the BP values for the meridians between pre- and post- kokyuhō. Regarding the change of the BP values between the pre- and post-kokyuhō, the females increased greater than the males. Moreover, the standard deviation of the mean BP values for the females shows a remarkably larger reduction than that of the males.

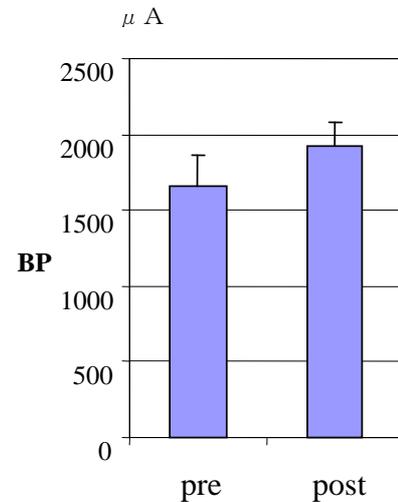
Male

t-test			
Male			$\alpha=0.01$
	pre-kokyuhō	post-kokyuhō	difference
Mean	1901.2	2101.12	199.92
SD	217.5	209.3	-8.2
Observations	45	45	
t Stat	-12.1169		
P(T<=t) two-tail	1.30E-15		
t Critical two-tail	2.692278		



Female

t-test			
Female			
	pre-kokyuho	post-kokyuho	difference
Mean	1661.44	1922.94	261.5
SD	206.3	161.8	-44.5
Observations	28	28	
t Stat	-10.3412		
P(T<=t) two-tail	6.88E-11		
t Critical two-tail	2.770683		

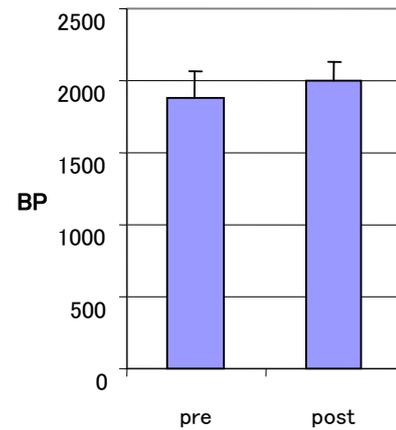


For both Black- and White-belts, there was a significant difference ($p < 0.01$, 0.001) of the BP values for the meridians between pre- and post- kokyu-ho. In terms of the magnitude of the increase of the BP values after kokyu-ho, the black-belts increased larger than the white-belts, which were $248.7\mu A$ and $200.7\mu A$, respectively. The results also show that the standard deviations of the mean BP values were reduced for both categories after kokyu-ho.

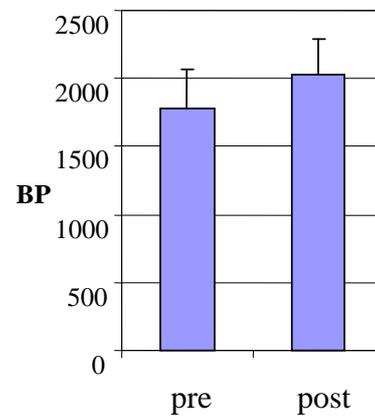
For the beginners, there was the significant difference ($p < 0.05$) of the BP values between pre- and post-kokyu-ho. However, the probability ($p = 0.04687$) for the beginners is quite higher than that of other ranks, which are $p = 6.17E-14$ for the black-belts and $p = 3.99E-12$ for the white-belts. The magnitude of the increase of the BP values for the beginners is only $112.37 \mu A$, which is less than a half of the magnitude for the black-belts ($248.72\mu A$).

Black-belts**t-test**

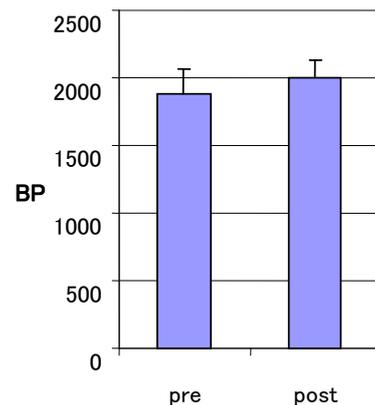
Black-belts	$\alpha=0.01$		
	pre-kokyuhō	post-kokyuhō	difference
Mean	1778.99	2027.71	248.72
SD	289.6	261	-28.6
Observations	33	33	
t Stat	12.586381		
P(T<=t) two-tail	6.17E-14		
t Critical two-tail	2.738481		

**White-belts****t-test**

White-belts	$\alpha=0.01$		
	pre-kokyuhō	post-kokyuhō	difference
Mean	1832.6	2033.32	200.72
SD	195.8	163.5	-32.3
Observations	40	40	
t Stat	9.8436939		
P(T<=t) two-tail	3.99E-12		
t Critical two-tail	2.707913		

**Beginners****t-test**

Beginner *	$\alpha=0.05$		
	pre-kokyuhō	post-kokyuhō	difference
Mean	1888.09	2000.46	112.37
SD	178.7	131.1	-47.6
Observations	8	8	
t Stat	2.4071915		
P(T<=t) two-tail	0.04697		
t Critical two-tail	2.364624		



* Beginner: Practitioners who have trained in Aikido for less than six months and were usually included in the white-belts in this study.

3.2 Different Change of ki energy among 14 meridians

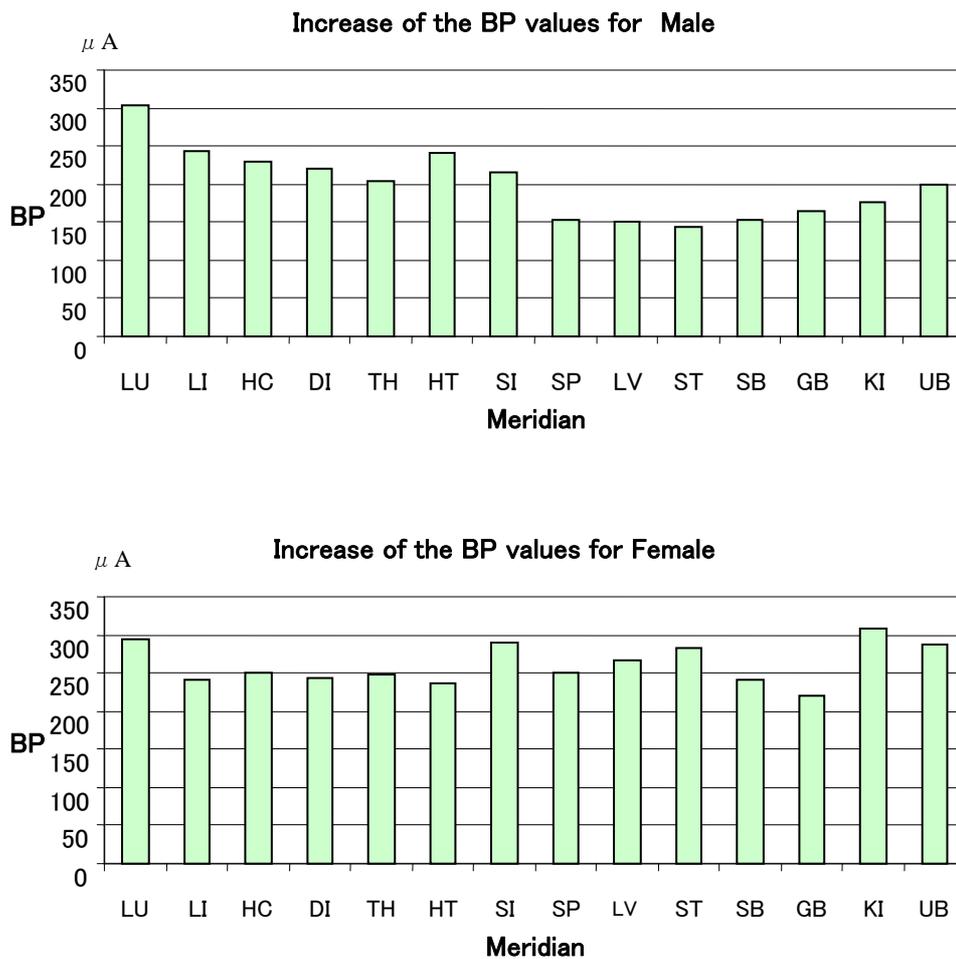
Comparison between Male and Female

Table 3-1 represents the mean increase of the BP values for each meridian after kokyu-ho for the male (n=45) and the female (n=28).

Table 3-1: Increase of the BP values for each meridian after kokyu-ho (μA)

	LU	LI	HC	DI	TH	HT	SI	SP	LV	ST	SB	GB	KI	UB
Male	303	242	230	220	204	241	216	153	152	143	152	165	177	199
Female	294	241	249	245	249	236	290	250	267	282	241	221	309	287

Figure 3-1



We can read from Figure 3-1 that the BP in the lower body meridians, except the UB, had a small increase compared to that of the upper body meridians for the male. On the other hand, for the female, we cannot see a prominent difference among the meridians regarding the increase of the BP values. In order to confirm statistically, One-Factor ANOVA was performed. The results of the test are shown below:

Table 3-2**Male** $\alpha=0.05$

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1240178	13	95398.33	3.006059	0.000266	1.736056
Within Groups	19548975	616	31735.35			
Total	20789153	629				

Female $\alpha=0.05$

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	253086.9	13	19468.22	0.451528	0.949398	1.746103
Within Groups	16297951	378	43116.27			
Total	16551038	391				

Table 3-2 shows that there is a significant difference among the 14 meridians ($p=0.00027 < 0.05$) regarding the increase of the BP values after kokyu-ho for the male,

whereas for the female, the significant difference among all meridians is not found ($p=0.949 > 0.05$).

Moreover, the Chi-square test was performed in order to examine statistically whether there is a significant difference between the male and the female in terms of the larger increase of the BP values when comparing the two groups.

Table 3-3 : Comparison of the Magnitude of the Increase of the BP values Between Male and Female

	Male		Female
LU	303	>	294
LI	242	>	241
HC	230	<	249
DI	220	<	245
TH	204	<	249
HT	241	>	236
SI	216	<	290
SP	153	<	250
LV	152	<	267
ST	143	<	282
SB	152	<	241
GB	165	<	221
KI	177	<	309
UB	199	<	287

Male > Female	3
Male < Female	11

df	1
χ^2 value	4.57
P value	0.0325
$\chi^2(0.95)$	3.84

The Chi-square test indicates that there is a significant difference between the males and the females regarding the increase of the BP values after kokyu-ho. The number of the meridians with a higher BP values between genders is eleven for the females, and three (LU, LI, and HT meridians) for the males. Accordingly, it is said

that for the female, the change of the BP values in the meridians is remarkably greater compared to that of the male.

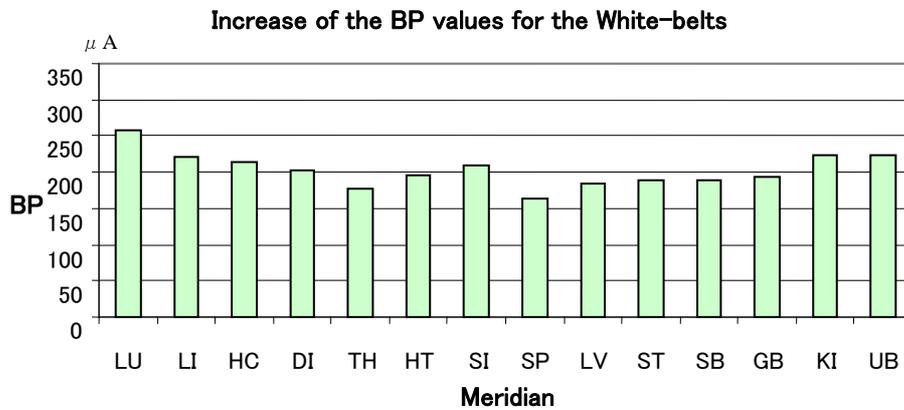
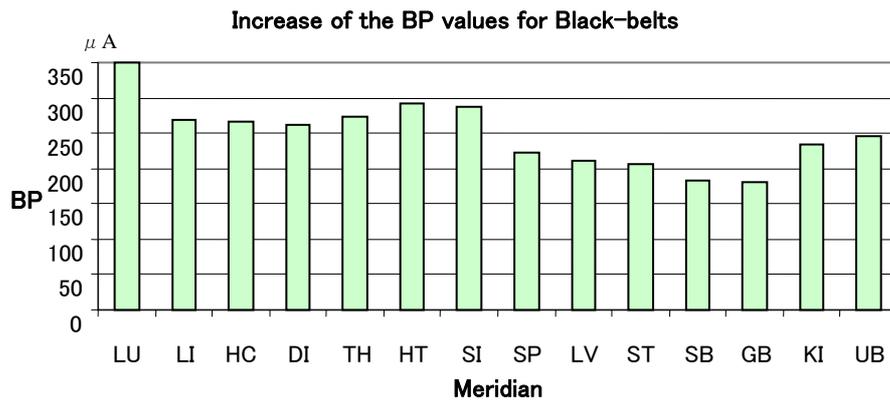
Comparison between the black-belts and the white-belts

Table 3-4 represents the mean increase of the BP values for each meridian after kokyu-ho for the black-belts (n=33) and the white-belts (n=40)

Table 3-4: Increase of the BP values for each meridian after kokyu-ho (μA)

	LU	LI	HC	DI	TH	HT	SI	SP	LV	ST	SB	GB	KI	UB
Black	351	268	265	261	274	293	287	223	212	206	183	180	233	246
White	257	220	215	203	177	195	209	163	183	189	189	192	223	222

Figure 3-2



As shown in Figure 3-2, the increase of the BP values in the lower body meridians is small compared to the upper body meridians for the black-belts. In contrast, the increase of the BP values in all meridians is more equal for the white-belts than that of the black-belts. Of the lower body meridians, the KI and UB meridians' BP values show a large increase for both the black- and white-belts.

The results of the ANOVA show that there is a significant difference among the 14 meridians ($p=0.0192 < 0.05$) regarding the increase of the BP values after kokyu-ho for the black-belts, while for the white-belts, there is no significant difference among all meridians ($p=0.846 > 0.05$).

Table 3-5

Black-belts

$\alpha=0.05$

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	942268.1	13	72482.16	2.002126	0.019182	1.742036
Within Groups	16218765	448	36202.6			
Total	17161034	461				

White-belts

$\alpha=0.05$

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	294957.7	13	22689.06	0.611288	0.845635	1.738099
Within Groups	20265764	546	37116.78			
Total	20560722	559				

3.3 Balance of ki energy

The difference of the BP values between the left and right side of the 14 meridians in both pre- and post-kokyu-ho were calculated for all subjects. The difference of the BP values between the left and right side of the meridian is symbolized as |L-R|.

Table 4-1 are the results showing the mean of the difference of the BP values between the left and right side of the 14 meridians for each category; such as all subjects, male/female, and black-belts/white-belts.

Table 4-1

All subjects			Male			Female		
meridian	pre L-R	post L-R	meridian	pre L-R	post L-R	meridian	pre L-R	post L-R
LU	149.6	174.0	LU	137.3	195.0	LU	169.3	140.1
LI	135.8	126.4	LI	155.4	122.9	LI	104.4	132.1
HC	153.9	144.5	HC	158.1	164.6	HC	147.2	112.1
DI	123.5	98.5	DI	120.8	103.0	DI	128.0	91.3
TH	124.1	120.5	TH	123.4	115.2	TH	125.1	128.9
HT	115.6	104.3	HT	119.4	121.0	HT	109.4	77.6
SI	123.8	106.0	SI	125.6	102.4	SI	120.8	111.8
SP	138.7	106.9	SP	151.7	100.5	SP	117.7	117.3
LV	161.6	116.9	LV	155.7	101.2	LV	171.2	142.2
ST	147.0	117.7	ST	169.6	101.7	ST	110.6	143.4
SB	111.8	103.9	SB	111.8	106.3	SB	111.8	100.0
GB	125.9	112.2	GB	130.0	106.7	GB	119.5	121.0
KI	168.4	152.7	KI	197.5	160.2	KI	121.5	140.8
UB	178.4	152.2	UB	168.2	167.4	UB	194.7	127.6
mean	139.9	124.0	mean	144.6	126.3	mean	132.2	120.4

Black-belts

meridian	pre L-R	post L-R
LU	156.2	174.8
LI	135.9	122.0
HC	174.9	162.0
DI	133.1	90.3
TH	133.7	117.6
HT	124.2	91.7
SI	127.8	122.9
SP	149.2	115.5
LV	175.9	123.2
ST	148.5	131.3
SB	129.3	121.8
GB	117.6	140.1
KI	181.1	164.9
UB	182.0	168.7

mean **147.8** **131.9**

White-belts

meridian	pre L-R	post L-R
LU	144.1	173.3
LI	135.8	130.0
HC	136.6	130.0
DI	115.6	105.3
TH	116.1	122.8
HT	108.5	114.8
SI	120.4	92.1
SP	129.9	99.8
LV	149.9	111.8
ST	145.7	106.5
SB	97.4	89.1
GB	132.8	89.3
KI	157.9	142.7
UB	175.4	138.5

mean **133.3** **117.6**

In order to examine whether there is a significant difference between pre- and post-kokyu-ho regarding the average of |L-R|, the Two-tailed paired t-test was performed for each category. Table 4-2 shows the results of the t-test.

Table 4-2: t-test: Paired Samples

All subjects		
	pre L-R	post L-R
Mean	139.858	124.048
Variance	2022.029	1264.370
Observations	73	73
Pearson		
Correlation	0.224563	
df	72	
t Stat	2.665491	
P(T<=t) one-tail	0.004742	
t Critical one-tail	1.666294	
P(T<=t) two-tail	0.009484	
t Critical two-tail	1.993464	

Male			Female		
	pre L-R	post L-R		pre L-R	post L-R
Mean	144.603	126.300	Mean	132.232	120.429
Variance	1639.265	1482.915	Variance	2622.847	933.012
Observations	45	45	Observations	28	28
Pearson			Pearson		
Correlation	0.107908		Correlation	0.407131	
df	44		df	27	
t Stat	2.326301		t Stat	1.307456	
P(T<=t) one-tail	0.012336		P(T<=t) one-tail	0.101041	
t Critical one-tail	1.680230		t Critical one-tail	1.703288	
P(T<=t) two-tail	0.024672		P(T<=t) two-tail	0.202083	
t Critical two-tail	2.015368		t Critical two-tail	2.051830	

Black-belts			White-belts		
	pre L-R	post L-R		pre L-R	post L-R
Mean	147.820	131.916	Mean	133.289	117.557
Variance	2288.826	1418.137	Variance	1757.066	1075.034
Observations	33	33	Observations	40	40
Pearson Correlation	0.044045		Pearson Correlation	0.364556	
df	32		df	39	
t Stat	1.533828		t Stat	2.325889	
P(T<=t) one-tail	0.067450		P(T<=t) one-tail	0.012658	
t Critical one-tail	1.693889		t Critical one-tail	1.684875	
P(T<=t) two-tail	0.134901		P(T<=t) two-tail	0.025315	
t Critical two-tail	2.036933		t Critical two-tail	2.022691	

Table 4-3

Categories	pre L-R	post L-R	difference	t-test, p
All subjects	139.9	124.0	15.8	0.00948 *

* p<0.05

The summarized results showed that the mean of |L-R| in the BP values decreased after kokyu-ho practice for all the categories (Table 4-3). The t-tests indicated statistically that for all subjects, there is a significant difference ($p=0.00948$) between pre- and post-kokyu-ho in terms of the mean of the difference of the BP values between the left and right side of the 14 meridians. That is, all subjects identified the decrease of |L-R| as a statistically significant phenomenon.

Table 4-4

Categories	pre L-R	post L-R	difference	t-test, p
Male	144.6	126.3	18.3	0.02467 *
Female	132.2	120.4	11.8	0.20208

*p<0.05

Comparing males and females, unlike the females, the males show a significant difference (p=0.02467) between pre- and post-kokyu-ho regarding the mean of |L-R|. The males exhibited a drastically decrease of the |L-R| in the meridians after kokyu-ho.

Table 4-5

Categories	pre L-R	post L-R	difference	t-test, p
Black-belts	147.8	131.9	15.9	0.13490
White-belts	133.3	117.6	15.7	0.02532 *

*p<0.05

When contrasting the black-belts and the white-belts, the white-belts present a significant difference (p=0.02532) between pre- and post-kokyu-ho regarding the mean of |L-R|, whereas there is no significant difference for the black-belts. The white-belts showed a significant decrease of the |L-R| after kokyu-ho.

3.4 Mutual Influence of ki energy

The purpose of this analysis is to reveal whether there is a mutual influence within the pair, which is an interaction of ki energy between partners, during kokyu-ho. In order to verify the mutual influence, the relationship between the partners' BP values was analyzed by using a scatter diagram and a correlation coefficient.

Explanation by Using Scatter Diagram

To display a scatter diagram, the following steps were used:

Table 5-1

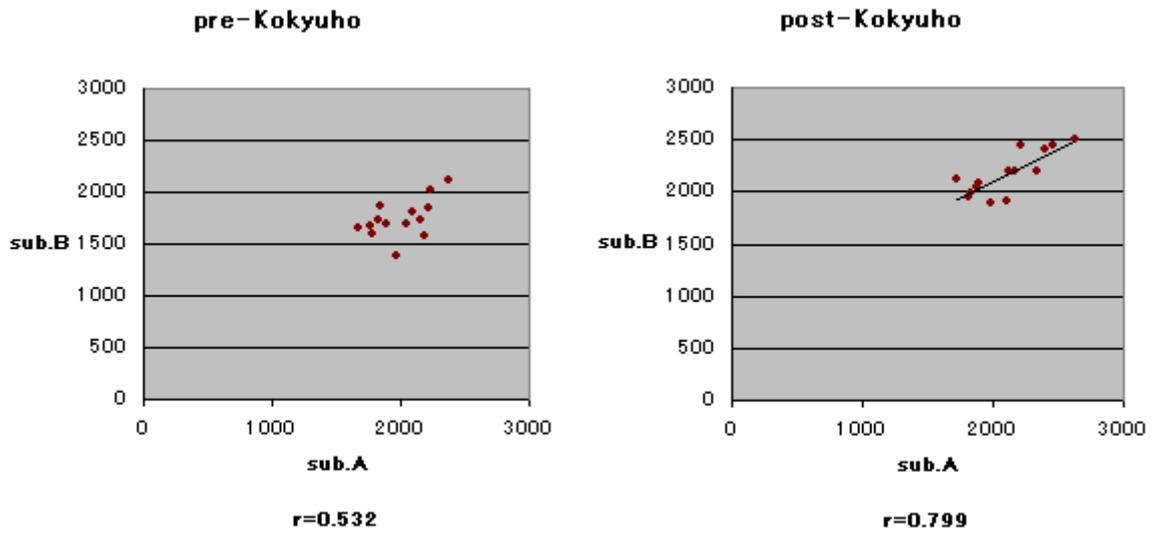
All units are the BP values in μA

1. The data were paired in a way that matched each of the BP values in a meridian for a subject, with corresponding BP values in the same meridian for the subject's partner. Table 5-1 provides an example of this data for explanatory purposes.
2. The paired data were plotted in a graph with a horizontal x-axis and a vertical y-axis.

The following scatter diagram represents the distribution of the BP values before and after kokyu-ho for the pair. As seen in the following examples, the BP values of one of the partners are put on the x-axis as "Sub. A," while those of the other are put on

	Before kokyu-ho		After kokyu-ho		
	sub. A	sub. B	sub. A	sub. B	
LU	2374	2116	LU	2632	2505
LI	1776	1591	LI	1991	1901
HC	1673	1659	HC	1813	1945
DI	1886	1701	DI	1872	2038
TH	1768	1678	TH	1834	1989
HT	1845	1868	HT	1889	2088
SI	1828	1738	SI	1731	2123
SP	2230	2023	SP	2469	2455
LV	2224	1844	LV	2213	2444
ST	2047	1689	ST	2116	2193
SB	2101	1800	SB	2166	2206
GB	2151	1724	GB	2333	2193
KI	2180	1585	KI	2400	2417
UB	1972	1384	UB	2111	1919

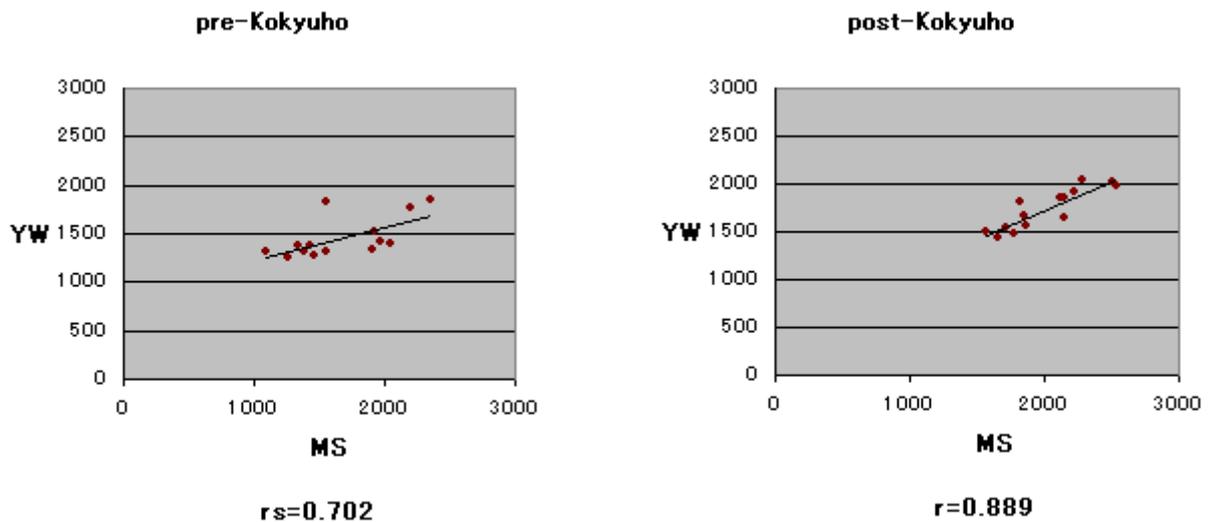
the y-axis as "Sub. B." The left diagram is a distribution of the BP values for the pairs before kokyu-ho, while the right diagram is that of the BP values after kokyu-ho.



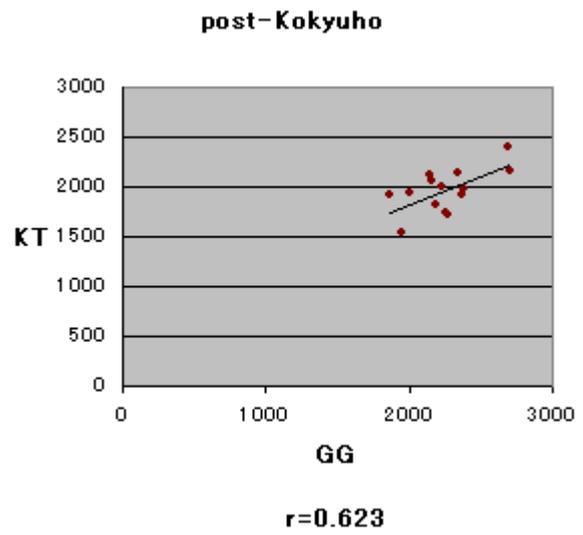
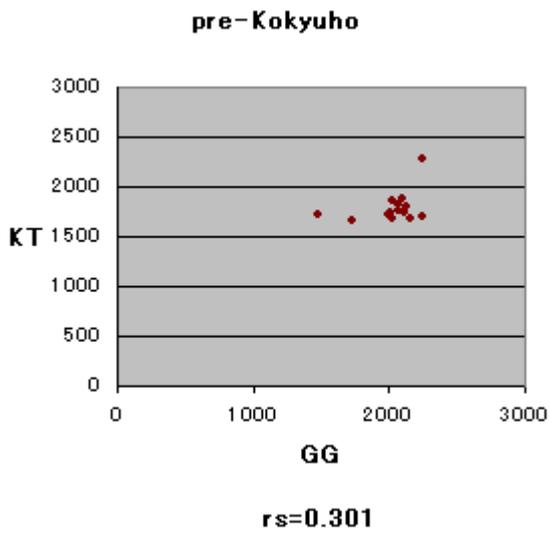
Critical value : 0.532 (Person r), 0.539 (Spearman rs)

The dots plotted in the left graph, pre-kokyuhō, are considerably scattered, whereas the dots plotted in the right graph, post-kokyuhō, are converged at a regression line. As these scatter diagrams show, the correlation between partners after kokyuhō expresses a much stronger relationship than before kokyuhō. Likewise, the post-kokyuhō correlation coefficient exhibits a greater value than the pre-kokyuhō coefficient, which are 0.799 and 0.532, respectively. Other scatter diagrams, which represent a similar tendency as discussed above, are shown below:

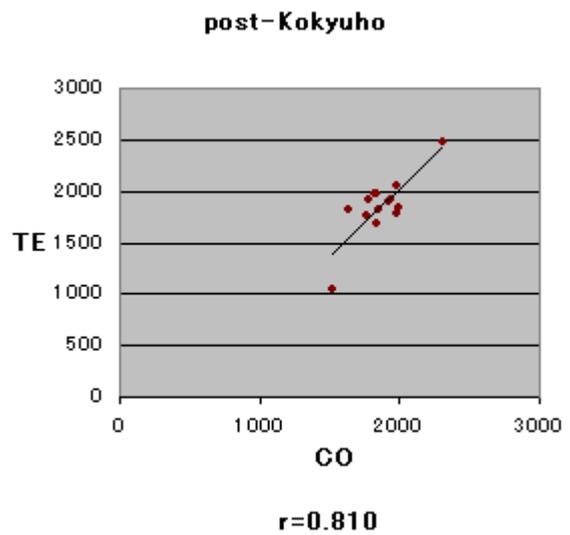
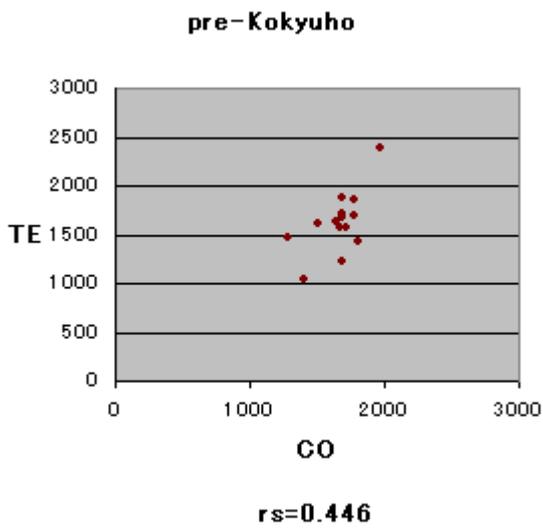
Pair #2



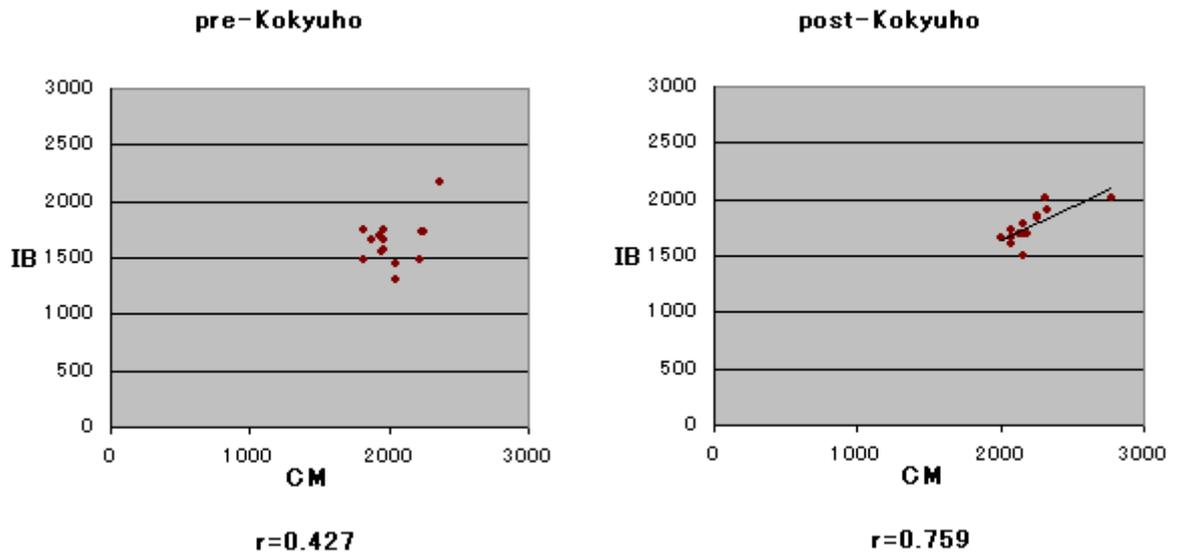
Pair #6



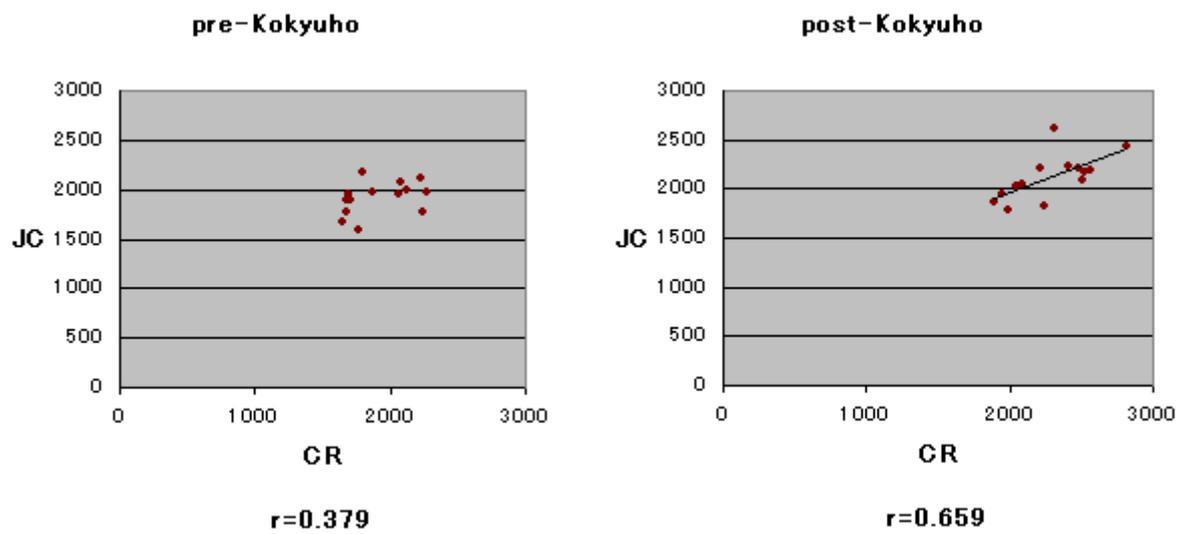
Pair #19



Pair #22



Pair #23



Review of Correlation Coefficient

The correlation coefficient was identified by the Pearson Product-Moment Correlation or the Spearman's Rank Order Correlation methods in order to investigate the correlation of the BP values in the meridians between the partners in a pair. The

results of the correlation analysis for all pairs before and after kokyu-ho appear in the following table.

Table 5-2: Increase or Decrease of Correlation Coefficient after Kokyu-ho

r : Pearson's coefficient , Critical Value: 0.532 rs : Spearman's coefficient , Critical Value: 0.539

	Pairs No.	Correlation coefficient		Increase
		Pre-	Post-	
1	1	r 0.755	r 0.782	0.027
2	2	rs 0.702	r 0.889	0.187
3	3	r 0.669	r 0.699	0.03
4	4	r 0.533	r 0.681	0.148
5	5	r 0.533	r 0.800	0.267
6	6	rs 0.301	r 0.623	0.322
7	7	r 0.732	r 0.834	0.102
8	8	rs 0.512	r 0.718	0.206
9	10	r 0.596	rs 0.609	0.013
10	13	r 0.425	rs 0.530	0.105
11	15	r 0.370	r 0.535	0.165
12	16	r 0.308	r 0.342	0.034
13	17	rs 0.556	r 0.777	0.221
14	18	r 0.615	r 0.772	0.157
15	19	rs 0.446	r 0.810	0.364
16	22	r 0.427	r 0.759	0.332
17	23	r 0.379	r 0.654	0.275
18	25	rs 0.481	r 0.697	0.216
19	26	rs 0.626	r 0.710	0.084
20	29	r 0.193	rs 0.385	0.192
21	30	r 0.284	r 0.487	0.203
22	32	r 0.720	r 0.798	0.078
23	33	r 0.563	r 0.689	0.126
24	34	r -0.108	rs 0.222	0.33

	Pairs No.	Correlation coefficient		Decrease
		Pre-	Post-	
1	9	r 0.708	r 0.597	-0.111
2	11	r 0.580	rs 0.314	-0.266
3	12	r 0.794	rs 0.516	-0.278
4	14	rs 0.613	rs 0.385	-0.228
5	20	r 0.239	r -0.077	-0.316
6	21	r 0.319	rs 0.002	-0.317
7	24	r 0.896	r 0.828	-0.068
8	27	r 0.804	rs 0.737	-0.067
9	28	r 0.601	rs 0.262	-0.339
10	31	r 0.736	r 0.730	-0.006

As shown in the Table 5-2, the correlation coefficient of 24 pairs out of 34 pairs increased after kokyu-ho, whereas that of 10 pairs decreased. To examine whether there is a significant difference between the 24 pairs increasing the correlation coefficient and the 10 pairs decreasing the coefficient, the Chi-square test was performed as follows:

Table 5-3

Pair	frequency
Increase of correlation coefficient	24
Decrease of correlation coefficient	10

$$\chi^2: 5.765, \text{ df: } 1, \text{ p: } 0.013, \chi^2(0.95): 3.841$$

The Table 5-3 reveals that the Chi-square test, $\chi^2=5.765>3.841$, demonstrated a significant difference in frequencies of number of pairs between the two groups.

Of the 10 pairs whose correlation coefficient decreased, some pairs showing a great correlation coefficient after kokyu-ho already had a very high correlation even before kokyu-ho. Therefore, those pairs caused a very slight decrease after kokyu-ho. Taking these into consideration, it is safe to say that the remarkable decrease of the correlation coefficient after kokyu-ho was about 20 percent. In other words, approximately 80 percent of all pairs created a strong, significant correlation between the partners during the kokyu-ho practice.

4. Discussion

4.1 Change of ki energy

The increasing BP values after kokyu-ho practice implies that kokyu-ho caused the activation of the function and amount of ki energy, which is represented by the BP values. Reducing the SD means that a degree to which raw BP values deviates from the mean became smaller for the subjects. This seems to indicate that the kokyu-ho technique evens out irregularities of the ki flow in the meridians for the practitioners. This reduction of the SD can be seen for all categories.

This result also shows that ki energy was enhanced after Aikido's kokyu-ho for both males and females. The differences between males and females are in the amount of the increased BP values (261.5 μ A and 199.9 μ A, respectively) and in the reduction of the SD (44.5 and 8.2, respectively) after kokyu-ho. The numbers of the increased BP values indicate that the females generated and flowed more ki energy than the males in this experiment. The reduction of the SD for females compared to the males suggests that ki energy in the meridians increased equally among the females. These unique phenomena allow us to consider that ki energy during kokyu-ho works differently depending on the gender.

There is a difference among the ranks regarding the probability of the t-test. This result provides an idea that the black-belts showed the most significant increase between pre- and post-kokyu-ho regarding the ki energy, while the beginners showed less change compared to the other categories. Therefore, it might be said that the quality of ki energy improves for the long-term (more than 4 years) and skilled practitioners.

Regarding the SD, the beginners reduced to the greatest degree compared to the other categories. While the activation of the ki energy for the beginners is less than that for the other categories, the increased ki energy in the meridians rises more equally among

the beginners. It could be explained that a short-term Aikido practice induces a similar effect on the practitioners, even within a small amount of the ki energy, because there is the same limited opportunity to practice for them.

4.2 Different change of the ki energy among meridians

The analyses showed that the ki energy increased significantly for each meridian after kokyu-ho. No meridian decreased in energy with practice of kokyu-ho. These results give us enough validity to express that the kokyu-ho causes ki energy to activate more strongly within the meridians.

There is a significantly different tendency between the males and the females in terms of the increased BP values in the meridians after kokyu-ho. For the males, as the aforementioned explanation, the fact that the LU, LI, and HT meridians activated much more than the lower body meridians. This fact might suggest that the muscular power was more dominant compared to the ki energy for males, because the respiratory organ, when viewed physiologically, is governed by both motor nerves and autonomic nerves. Moreover, both voluntary and involuntary muscles are attached to the lungs, which work for breathing in the kokyu-ho.

On the other hand, for the females unlike the male, we can see a remarkable increase of the BP values in the SI, ST, KI, UB meridians, most of which are the lower body meridians. According to Motoyama (2003), an area (called “*chukan*” in Chinese) immediately above the stomach, belonging to the ST meridian, is considered as a center of receiving the ki energy and is associated mentally with the emotions. The activation of the ST meridian might express one of the unique characters for females. The SI, KI and UB meridians are strongly related to the *seika tanden*, where it is said that the ki energy is generated. The fact that the BP values increased in these

meridians made is possible to imagine that ki energy was produced mainly around or within the lower abdomen. These meridians also belong to the uterus, which is the center of the reproductive system that is very important functions for the females. The innate workings of the females might cause the result that the ki energy flows well in the lower meridians.

A significantly different trend is seen between the black-belts and the white-belts in terms of the increased BP values in the meridians after kokyu-ho. A noteworthy change of the BP values is shown in the upper body meridians, such as the LU, HT, SI meridians, for the black-belts, whereas there is no remarkable difference among the 14 meridians for the white-belts. Most notably, the quantity of the increased BP values in each meridian for the black-belts is larger than that of the white-belts. This means that the ki energy is produced and flowed much more for the black-belts during kokyu-ho, particularly in the upper body meridians, compared to the white-belts who seemed to use a little ki energy during this practice. This demonstrates that the black-belts have an eminent ability to generate and circulate the ki energy in their body by the Aikido technique, kokyu-ho. It also might be said that at the early stage of the Aikido training, the physical energy works in the muscular system and then, the ki energy starts to flow through entire body for the skilled practitioners.

4.3 Balance of ki energy

The |L-R| (difference of the BP values between the left and right side) of the 14 meridians after kokyu-ho is smaller compared to that before kokyu-ho. This finding indicates that the imbalance of the left and right sides of the meridians was diminished during the kokyu-ho practice. In the other words, the imbalance of function and ki energy of the left / right side of the body were more balanced through kokyu-ho. In

this study, for the males as well as the white-belts, especially, the balance restored in the meridians showed significant changes in the |L-R|.

It can be surmised that the function and the ki flow of the meridians were harmonized by kokyu-ho. Traditional Chinese Medicine advocates that health is balanced and harmonized in the bodily energy system. Therefore, we can say that the kokyu-ho makes it possible to preserve a good balance in the ki flow and causes us to maintain our life and strength.

Although there is no significant difference among the 14 meridians concerning the change of the |L-R| between pre- and post-kokyu-ho for most categories, except the males, the tendency that the |L-R| after kokyu-ho decreases can be seen for all categories:

Male; **LI, DI, SI, SP, LV, ST, and KI.**

Female; **LU, HC, TH, HT, LV, SB, GB, KI, and UB.**

Black-belts; **LI, DI, TH, HT, LV, and ST.**

White-belts; **HC, DI, SI, SP, LV, ST, and KI.**

The LV, GB, SP, ST, LI, and SI meridians distribute ki energy and are closely related to the digestive system, while the KI, UB, SI, LV, and TH meridians distribute ki energy and are related to the urogenital system (Motoyama, 1991). Therefore, it might be suggested that the Aikido's kokyu-ho is a useful exercise to activate or renovate the digestive system, which is likely to receive ki energy, as well as the urogenital system, which is related to the *seika tanden* where ki is generated.

4.4 Mutual influence of ki energy

The data with the AMI in this study showed that the BP values in the meridians for each subject changed closer to that of the other subject in a pair after kokyu-ho. Based

on these analyses, significant correlations were seen in the ki level after kokyu-ho along the corresponding meridians of the partners. In other words, the kokyu-ho causes a strong correlation between the partners in a pair.

Thus, the kokyu-ho enhanced the degree of correlativity in the ki energy of the pair, and developed a more intimate relation of union between the partners. These results support an idea that during kokyu-ho, the ki energy of a partner transfers to the other partner as if a synchronization of the meridian functioning occurred. Therefore, the exchanging ki between the partners produces a mutual influence throughout the meridians, which are energy routes that link two physical bodies.

Incidentally, in this experiment, some pairs had already a high correlation coefficient even before practicing kokyu-ho. The subjects were put closely in the same room, when measured by the AMI device. It is inferred that this situation induced them to synchronize in the ki energy before kokyu-ho. That is, by means of some kind of interaction, the ki energies of the two subjects might alter toward a similar pattern of the functioning.

5 Conclusion

The numerical results obtained show;

- 1. The average of the BP values after practicing kokyu-ho are significantly greater than that of the BP values before kokyu-ho.**
- 2. Between the pre- and post- kokyu-ho, there is a significant difference in the change of the BP values among the 14 meridians.**
- 3. The average of the difference of the BP values between the left and right side of the 14 meridians decreases after practicing kokyuhoh and there is a**

significant difference among the 14 meridians regarding the increase or decrease of the difference.

- 4. There is a statistically significant correlation between two practitioners in a pair regarding the BP values in the 14 meridians during kokyu-ho.**

We, thus, conclude that ki energy in the body was activated and balanced by the Aikido technique, and that ki energy resonated between the partners, which suggests the “*Aiki*” phenomenon.

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