

6-2. THE BIOCHEMICAL STUDY ON THE INFLUENCE OF TRAINING CAMP OF TOP WOMEN JUDOISTS

Shukoh HAGA (University of Tsukuba), Teruo KAISE (Tokyo Gakugei University), Takudo MIZUTA (University of Electro-Communications), Kiyomi UEYA (University of Yamanashi), Keiko ANDO (Nihon Women's University), Mitsuhiro SUGIYAMA (University of Ehime), Haruko NIBOSHI and Shinichi OIMATSU (Kodokan), Yoshimi OSAWA (Waseda University)

We⁷⁾ have been doing the biochemical research of properties of blood and hormone systems of the women Judo candidates for international championship as subjects in order to observe the influence of Judo practice on the characteristics of women. As a result it was known that there was almost no change in body weight after the regular reinforcement practice and also there was no change in the properties of blood among the values of albumin, urea, creatine, uric acid, serum total cholesterol, HDL cholesterol and they stayed within the normal range. Creatine phosphokinase (CPK), lactate dehydrogenase (LDH), and glutamic oxalacetic transaminase (GOT) showed the tendency to increase gradually from the morning practice to the afternoon practice, however, every value stayed in the supremum of the normal range. There was no change observed in blood triiodo thyronine and blood thyroxine. We have already pointed out that the Judo practice for women is not too severe an exercise for them at all. In this survey we studied the influence of training camp on women, which its intensity and quantity of the practice are quite large.

I. Method

1. Subjects

TABLE 1 The Age and Physical Characteristics of Women Judoists

Subj.	Age (years)	Height (cm)	Weight (kg)
H. S.	22	172	71.5
H. F.	26	170	67.5
N. H.	21	166	60.0
K. H.	16	161	63.0
S. H.	26	158	59.5
T. N.	26	160	57.0
M. Sas	25	165	63.0
M. Si	21	158	56.0
K. Y.	15	160	51.0
N. Ha	24	153	49.0
H. N.	18	156	50.0
M. Sai	18	148	40.0
M	21.8	160.6	58.0
(SD)	3.86	6.58	7.12

The subjects are 12 members of candidates for the Consolidating All-Japan Women Judo Players, whose ages and physical characteristics are shown in Table 1. The youngest of the subjects was 15 and the oldest was 26. The average body height of the subjects from the light-weight class to the heavy-weight class was 160.6 cm and the average body weight was 58.0 kg.

2. Procedure

The experiment was done during the women's Judo reinforcement training camp from August 4th to 9th in 1980. The subjects stayed at the Kodokan from the night before the first day of the training camp. The total of 5 measurements were done on the first day as shown below.

Measurement 1: Got up at 7 a.m. After urination blood was drawn from the elbow veins at the rest state. At the same time the body height, body weight, rest-period blood pressure, and rest-period heart rate were measured.

Measurement 2: Just before the morning workout from 9 a.m. to 9:30 a.m. the blood was drawn and the measurements were done in the same way.

Measurement 3: Measured immediately after the morning practice.

Measurement 4: Measured just before the afternoon practice from 13:30 to 14:00.

Measurement 5: Measured immediately after the afternoon practice. *Breakfast was taken at 7:30 a.m. and lunch at noon.

3. Contents of Workout

The practice was held for two hours in the morning (mainly *katamewaza*). The afternoon practice was held for two hours and half from 14:00 to 16:30 (mainly *nagewaza*). Namely, *kakari-rensu* and *yakusoku-rensu* adding *kakari-rensu* and *ido* (movement) and the review of relative techniques from *nagewaza* to *katamewaza* were practiced.

II. Results

The change of body weight before and after the practice in the morning and afternoon practice is shown in Table 2. The body weight decreased 1.0 kg in the morning practice and decreased approximately 1.5 kg in the afternoon practice from the average. The same tendency before and after the training camp was observed. There was almost no change in body weight through the training camp of women Judo.

TABLE 2 The Change of Body Weight Before and After Practice on the First Day and the Last Day of Training Camp

Subj.	Weight (kg)							
	A.M.				P.M.			
	Before Pre.	Exercise Post.	After Pre.	Exercise Post.	Before Pre.	Exercise Post.	After Pre.	Exercise Post.
H. S.	71.5	73.5	70.8	72.5	72.2	73.7	71.0	72.0
H. F.	67.5	66.0	66.0	64.7	67.0	66.0	65.5	65.0
N. Ho	60.0	61.0	59.0	60.0	60.0	60.5	58.5	59.0
K. H.	63.0	62.0	61.0	60.7	61.5	61.7	59.5	60.0
S. H.	59.5	60.5	58.2	59.0	59.0	59.5	58.0	58.5
T. N.	57.0	57.5	56.0	56.5	57.5	57.5	55.5	56.0
M. Sas	63.0	63.0	62.0	61.2	63.0	62.3	60.2	60.5
M. Si	56.0	56.0	55.0	54.5	55.5	55.5	54.0	54.0
K. Y.	51.0	51.0	50.4	50.0	50.7	50.5	50.0	49.8
N. Ha	49.0	49.5	48.5	48.5	50.0	48.5	49.0	48.0
H. N.	50.0	49.5	48.3	48.5	48.9	49.3	48.2	48.0
M. Sai	49.0	48.0	47.5	47.0	48.1	47.5	46.5	46.2
M	58.04	58.12	56.89	56.92	57.78	57.7	56.32	56.41
(SD)	7.122	7.405	7.097	7.324	7.239	7.577	7.038	7.376

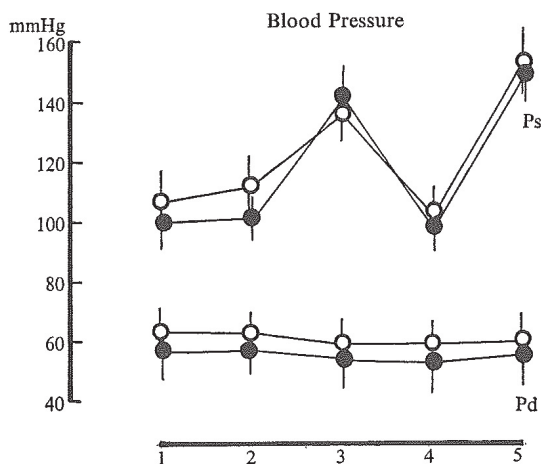


Fig. 1 The Change of Blood Pressure on the First Day and the Last Day of Training Camp

TABLE 3 The Change of Heart Rate Before and After Practice on the First Day and the Last Day of Training Camp

Subj.	Heart Rate			
	A.M.		P.M.	
	Pre.	Post.	Pre.	Post.
H. S.	138	126	156	168
H. F.	96	120	144	144
N. Ho	144	138	168	162
K. H.	156	156	162	168
S. H.	150	150	180	156
T. N.	114	138	162	168
M. Sas	156	156	168	168
M. Si	168	162	186	180
K. Y.	114	138	144	162
N. Ha	120	120	138	144
H. N.	120	156	168	162
M. Sai	144	144	174	180
M	135.0	142.0	162.5	163.5
(SD)	20.9	13.9	14.2	11.0

The change of blood pressure before and after the training camp is shown in Fig. 1. The first day of the training camp is shown with "O" mark and the last day is shown with "●" mark. The systolic blood pressure of immediately after getting up and after breakfast and lunch was approximately 100 mmHg. The diastolic blood pressure was approximately 60 mmHg. However, it increased to 138 mmHg immediately after the practice in the morning and afternoon. Especially, high values were shown in the afternoon training when *tachiwaza* was mainly practiced. The result of the last day of this training camp was that the value of immediately after the practice in the morning and afternoon showed almost the same tendency as the result of the first day of training camp. However, the systolic blood pressure and diastolic blood pressure at the rest period showed a lower value than the first day of training camp.

The heart rate during the practice in the morning and afternoon was measured for 10 seconds by palpation and it was converted to the value of one minute. The result is shown in Table 3. In the morning practice of the first day of training camp the heart rate was from 96 beats/min. to 168 beats/min. The average was 135 beats/min. On the last day of the training camp it was from 120 beats/min. to 162 beats/min. Generally, they responded higher than before the training camp. It was 142 beats/min. on average. On the other hand, only two to three subjects showed the rate under 150 beats/min. in the afternoon practice, and most of them remained in the range of 150–180 beats/min. The average before this training camp was 162.5 beats/min. and the average after the training camp was 163.5 beats/min.

In the properties of blood, there is albumin which maintains plasma permeation pressure, keeps the balance of water in tissue and blood vessels, and transfers the produced substance to the organs. The albumin is produced by synthesizing amine acid in liver. The value of albumin did not change at the rest period and after the practice, and kept within the normal range before and after the training camp. The average value was 3.8–4.5 g/dl.

Sodium (Na) and potassium (K) in the cell fluid, maintain physiological actions to keep acid-base balance and permeation pressure, to defend body fluid loss, to keep the diffusion of cell membrane, and to provide agitation conduction of nerves and muscles. In the change of sodium before the training camp the value was higher after the afternoon practice than the morning practice. The value after the training camp showed higher in the morning than in the afternoon. The change was

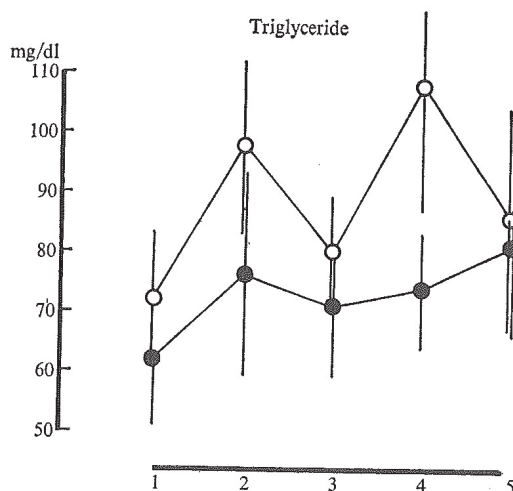


Fig. 2 The Change of Triglyceride on the First Day and the Last Day of Training Camp

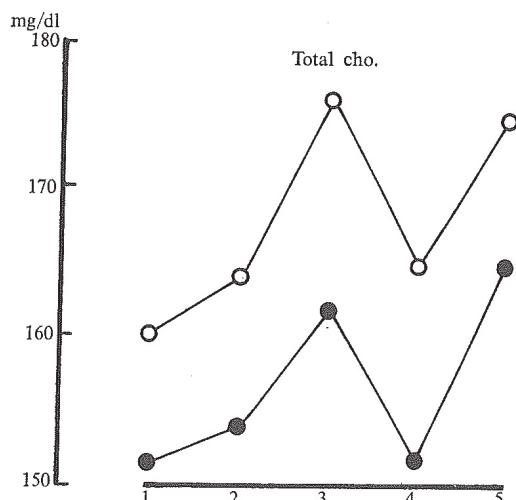


Fig. 3 The Change of Total Cholesterol on the First Day and the Last Day of Training Camp

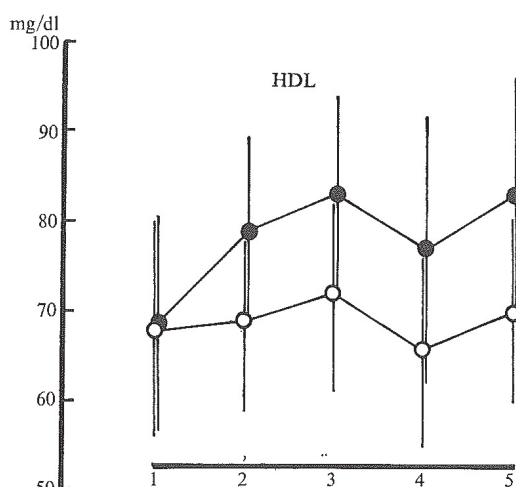


Fig. 4 The Change of HDL Cholesterol on the First Day and the Last Day of Training Camp

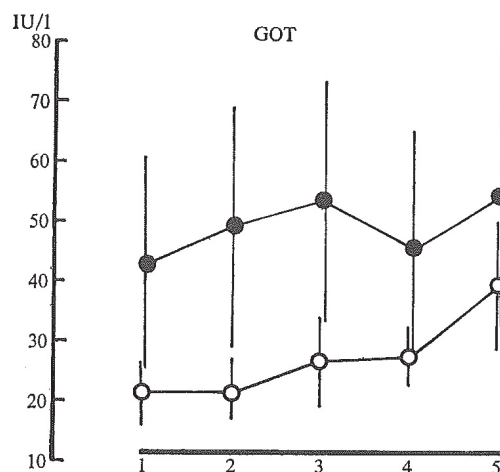


Fig. 5 The Change of Glutamic Oxalacetic Transaminase on the First Day the Last Day of Training Camp

within 134–147 mg/l which is considered to be the normal value of sodium, and it was also the movement within the daily fluctuation. From these results it seems that there was almost no change during the training camp. The value of potassium showed no difference between before and after the training camp (3.7–4.1 meq/l). Since the normal value is 3.2–4.7 meq/l, there was no influence after the training camp.

Creatine is produced by the combine of methyl (CH₃) of S-adenosylmethionine receiving the action of guanidoacetic acid transmethylferase in liver after the change of glycine into guanidoacetic acid. Usually creatine stays in the state of creatine phosphate and becomes the energy source of muscular contraction. The normal value is 0.7–1.4 mg/dl. The values before and after the training camp were 0.9–1.2 mg/dl. There was almost no change.

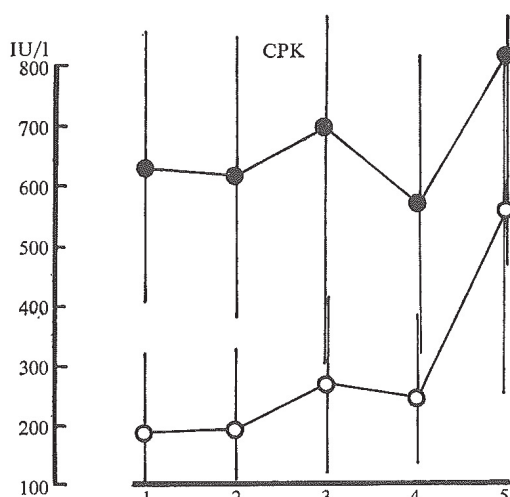


Fig. 6 The Change of Creatine Phosphokinase on the First Day and the Last Day of Training Camp

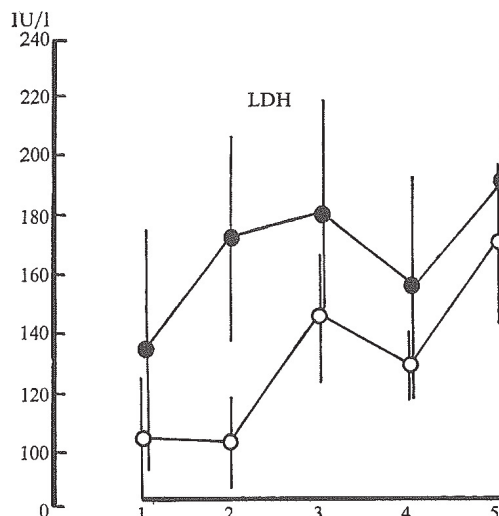


Fig. 7 The Change of Lactate Dehydrogenase on the First Day and the Last Day of Training Camp

Concerning blood lipid, the lipid in blood is insoluble into water and exists as lipoprotein combined with protein. There are four kinds: triglyceride (neutral fat), cholesterol, phospholipid, and free fat acid.

The result of triglyceride is shown in Fig. 2. The value of this substance before the training camp increased to 100–110 mg/dl after the practice in the morning and afternoon. However, it did not increase very much after the practice after the training camp. The value stayed in the range of 70–80 mg/dl, which is rather a low value compared with the value before the training camp.

The result of total cholesterol is shown in Fig. 3. In here cholesterol shows a high value immediately after the practice in the morning and evening. On the other hand, before and after the training camp, the value after the training camp was lower immediately after the workout as well as at the rest period.

The value of HDL cholesterol (high density lipoprotein) which is now drawing attention as a preventing factor of atherosclerosis is shown in Fig. 4, which shows no remarkable change after a day's practice. However, the value itself showed higher after the training camp than before the training camp. It indicates that HDL cholesterol increases through the training camp practice.

Glutamic oxalacetic transaminase (GOT) transfers amino of asparaginic acid to α -ketoglutaric acid. It is contained in the heart muscles and increases when the heart becomes loaded. The change of GOT is shown in Fig. 5. The value maintains low before the training camp, but it increases remarkably immediately after *tachiwaza* practice in the afternoon. On the last day of the training camp the value increased largely at the rest period and the practice period.

Creatine phosphokinase (CPK) which acts between creatine phosphate and creatine, is a catalytic enzyme of Lohmann Response. It acts on creatine phosphate, combines with ADP, and synthesizes ATP. As the result of this survey (Fig. 6), CPK showed remarkably a high value immediately after the afternoon practice (mainly *tachiwaza*). In the comparison of before and after the training camp, the values of the last day of the training camp were 600–650 IU/ml at the rest period, and 700–800 IU/ml at the practice period, which showed a remarkable increase.

Lactate dehydrogenase (LDH) is an enzyme to catalyze the response between pyruvic acid and lactic acid. It utilizes pyruvic acid in the final stage of anaerobic glycolysis of the metabolic route. It

is also an essential enzyme to produce ATP. The value of LDH increased in the morning practice focussed on *newaza* and in the afternoon practice in which *tachiwaza* was the main program, however, the value was higher immediately after the practice of *tachiwaza*. In the comparison of before and after the training camp, the value increased remarkably higher on the last day of this training camp, which was the same as CPK (Fig. 7). (blood hormone omitted in this survey)

III. Discussion

Concerning albumin, sodium, potassium and creatine that act to keep the inside circumstances of organism maintaining the acid-base balance and permeation pressure, there was no influence of the practice and almost no change was observed during the reinforced practice of the training camp, which seems to have something to do with the fact that body weight did not change. It is conjectured that there must have been a change in the factor to maintain these inner circumstances if body weight decreased because of the practice or the intentional reduction of body weight.

However, in the case of blood lipid, there was a remarkable change by the training camp. Triglyceride and total cholesterol which are neutral fat, showed quite a large decrease by the training camp, and on the other hand, HDL cholesterol increased.

Triglyceride has a role of storing energy and of maintaining body temperature and protecting ourselves from injury. The decrease of triglyceride by the training camp indicates that there was no supply from the subcutaneous fat because of unchanging body weight, and it also indicates that the triglyceride in blood was produced to supply the shortage of energy sources (glucose and glycogen) which consumed by practice.

Total cholesterol is mainly synthesized in the liver and small intestine. It also plays a very important role as an energy source as well as sugar. The value at the rest period before the training camp was 160–165 mg/dl on average, and it was 180 mg/dl at the exercise period. These values are all ideal and the change is within the normal range. The value after the training camp both at the rest and exercise periods decreased approximately 10 mg/dl before and after the training camp. This seems to be the result from participating in displaying energy. On the other hand, HDL cholesterol prevents permeation and composure of HDL cholesterol of the inside of vessels, and is drawing attention recently as the substance containing anti-atherosclerosis act.⁶⁾ It is reported that the value is high among athletes and low among non-athletes.⁴⁾ Adding a clinical view to the fact that HDL cholesterol increased after the training camp, and regular practice are effective to prevent atherosclerosis and ischaemic heart disease. Haga and his colleagues³⁾ reported that HDL cholesterol increases with a long period of physical endurance training even by aged people at the age of 70 on average. The result of this survey that HDL cholesterol increases after only a week-long training camp should be remarkably noted.

GOT is an enzyme to participate in the movement of heart muscles. It showed a higher value in the *nagewaza* workout focussed on *tachiwaza* than *katamewaza* workout. The tendency matches with the preceeding report.⁷⁾ In the case of *nagewaza*, the heart rate was higher than *katamewaza*. In some cases it was over 180 beats/min. which was the highest. The exercise intensity is larger in *nagewaza* than in *katamewaza* because *taisabaki* has to employ *waza* accompanied with a lot of movements of feet. *Nagewaza* requires a large load on the heart vascular system because of the anaerobic exercise movement added to when using *waza* by momentarily stopping breathing. Also it seems to have influence on blood pressure. The reason that the result of the last day of the training camp showed a high value is probably that the load on heart muscles became heavier with the increase of the practice intensity and quantity and the accumulation of fatigue.

The increase of CPK by exercise deviates from blood by the damage or destruction of muscular cells and contraction of span of life. It is reported that the value became 600 IU/l during the training camp for women athletes.⁵⁾ In this survey, the average value immediately after the *nagewaza* prac-

tice in the afternoon was approximately 850 IU/l, which indicates that the *nagewaza* practice was a very hard exercise. Since there were 4 persons over 1 000 IU/l, the load was heavy in the training camp for women Judoists.

There is no consensus of opinion yet concerning the relation between LDH and the practice intensity and relevance.^{1,2,8,9)} As mentioned at page 000 about GOT, the rise of LDH is caused by the movement of aerobic exercise and in the meantime an anaerobic factor is added. It also has something to do with the intensity of practice. The high value after the training camp seems to come from the accumulation of these exercises of high intensity.

Considering about these results, after the women's Judo training camp with the following can be said: being different from other athletic events, Judo practice requires to make use of muscle strength; *katamewaza* requires muscle endurance with some anaerobic exercise GOT, CPK, and LDH increase remarkably on the last day of the training camp, because of the accumulated fatigue at the training camp. Even though these values do not give overload or exhaustion at all to the body, the continuation of the practice for a week would be quite a load. However, it is impossible to discuss any further, since the comparison with other athletes is not possible. On the other hand, there is an interesting result from the field of preventive medicine that HDL cholesterol increased by the training camp. We would like to keep on making further studies in this field.

IV. Conclusion

1. Choosing 12 candidate members of All-Japan Women's Judo International Championship as the subjects of this study, a survey was made as to the influence of the training camp on women from the field of blood biochemistry.
2. The average age of the subjects was 21.8, the average height was 160.6 cm, and the average of their weight was 58.0 kg.
3. The change of systolic blood pressure was approximately 140 mmHg in *newaza* practice in the morning, and increased to 160 mmHg in *tachiwaza* practice in the afternoon. However, before and after the training camp, the value was almost the same.
4. Sodium and potassium participating in acid-base balance, permeation pressure balance, and humoral regulation, and creatine participating in muscular contract did not change before and after the training camp.
5. In blood lipid, triglyceride and total cholesterol decreased after the training camp, at the rest period and also at the exercising period.
6. HDL cholesterol showed a high value after the training camp than before the training camp. The increase was observed as a result of the training camp.
7. GOT, CPK and LDH increased remarkably as a result of the training camp.
8. The training camp being different from one-day Judo practice, it produces quite a change in the body. It does not exceed the limits. However, it is conjectured that the practice intensity becomes quite high.

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