

# The Effect of Judo on Blood Pressure

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## Foreword

In recent years, there is a general tendency toward the increase, throughout the world, in the number of patients with hypertension (11). It is common knowledge that during the performance of sports or other physical exercises there occurs a rise in blood pressure, but in most cases the athletes are young people, and there is no fear of immediate danger to their circulatory system. However, judo is practiced irrespective of age, hence a study of the effect of judo on the blood pressure of subjects both young and old is necessary.

In order to investigate the immediate and temporary effect, and the permanent effect of judo on the circulatory system, a study was made on the changes in blood pressure during judo matches and training exercises, together with a study of the blood pressures at rest, and also the blood pressure regulating function of judomen who had been undergoing training for many years.

## Experimental Procedure

Cubital blood pressure was measured with a mercury manometer by the auscultatory method. As experimental subjects grade holders who had been continuously training at the Kodokan were selected.

In order to ascertain the temporary effect of judo the changes in the blood pressure and the pulse rate during a throwing technique and a choking technique were measured. Also, the changes in blood pressure before and after each feat were measured.

To study the permanent effect of judo, the blood pressure distribution at rest of high grade holders who had been training for years were measured. Also their blood pressure regulating function was studied by determining their postural reflex.

Blood pressure measurements were made in the supine posture, except those made before and after the throwing technique, in which case the sitting posture was adopted.

## Results

1) Temporary effect on blood pressure. (i) Throwing technique—Blood pressure and pulse rate measurements were made at rest on the offensive and the defensive prior to the performances. Immediately after the measurements were taken the subjects were made to perform the throwing technique (hip technique) continuously at five second intervals. Blood pressure and pulse rate measurements were taken after every ten successive feats.

The changes in blood pressure and pulse rate of the offensive were identical to those observed during other physical exercises i. e. immediately after ten successive feats the

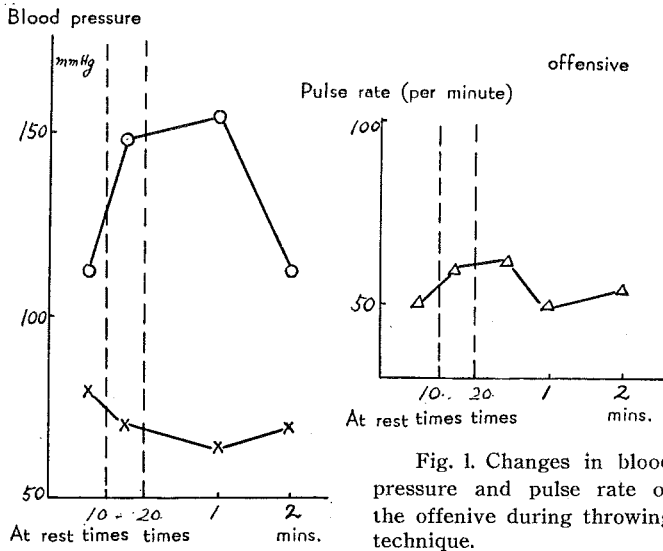


Fig. 1. Changes in blood pressure and pulse rate of the offensive during throwing technique.

systolic pressure increased 40mm Hg, returning to normal level after two to three minutes. The diastolic pressure decreased 5 to 10 mmHg, and the pulse rate increased. After another ten successive feats the changes observed were nearly identical to those observed after the first ten successive feats (Fig. I.)

Blood pressure and pulse rate changes observed on the defensive resembled those of the offensive in spite of the difference in the strain between

the two performers. The systolic pressure rose 30 to 50 mmHg, the diastolic pressure lowered slightly, and the pulse rate increased. Similar changes were observed after ten

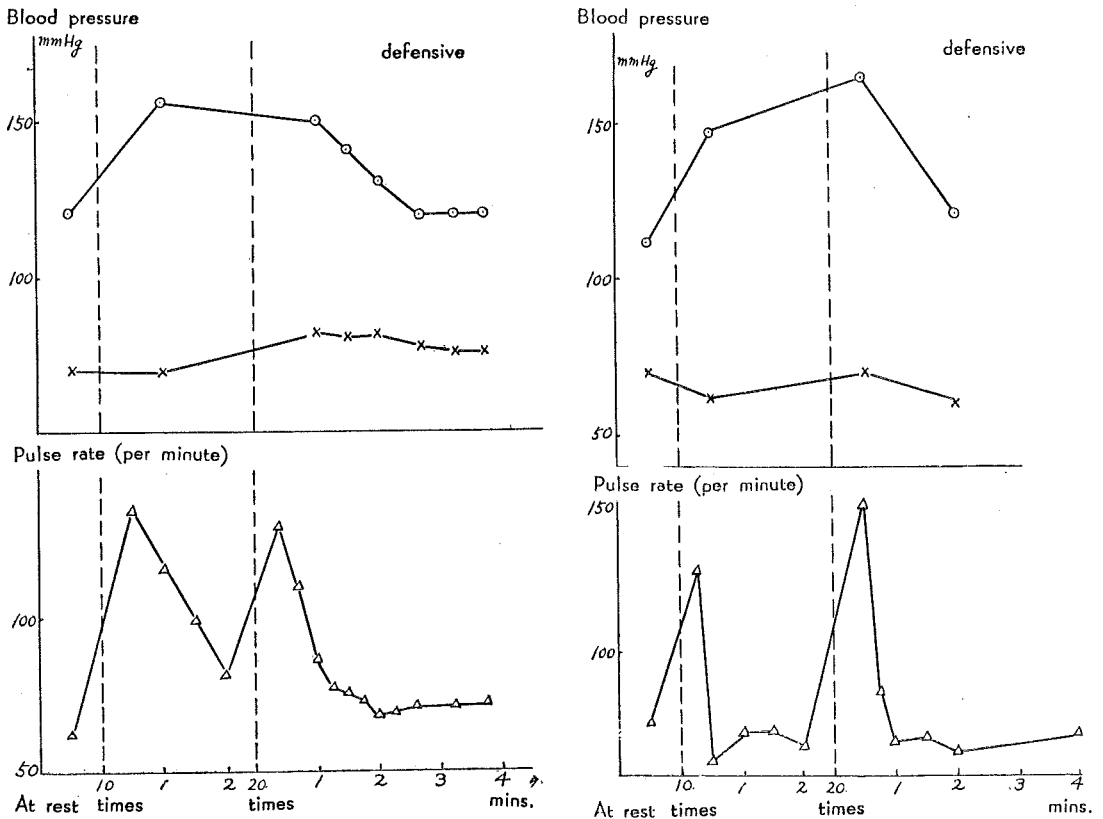


Fig 2. (A) Changes in blood pressure and pulse rate of the defensive during throwing technique. Normal revival of pulse rate.

Fig 2. (B) Changes in pressure and pulse rate of the defensive during throwing technique. Arrhythmia observed.

successive feats.

The changes in pulse rate of the offensive and the defensive in most cases were identical, generally increasing immediately following the performances and returning to normal level after two to three minutes. However, in a few cases in the defensive the pulse rate increased markedly directly following the performances, and within one minute decreased abruptly to a level lower than the normal. Arrhythmia was sometimes observed during such manifestations of bradycardia (Fig. 2).

(ii) Choking technique.—Blood pressure measurements were made on the defensive directly after the Okurierishime, Katajuji-shime and the Hadaka-jime. During the unconscious stage resulting from the stangle hold, measurements were hindered due to the convulsions, so they were taken directly after the subjects resumed consciousness, and continued taking measurements at various intervals for thirty minutes. Directly after resuming consciousness the systolic pressure registered an increase of 40 mmHg, and within one minute abruptly decreased, returning to normal level after five to ten minutes. Thirty minutes after resuming consciousness the measurements registered normal values. The diastolic pressure also showed an increase directly after resuming consciousness, but the increase was only slight, as a result the pulse pressure increased. (Fig. 3).

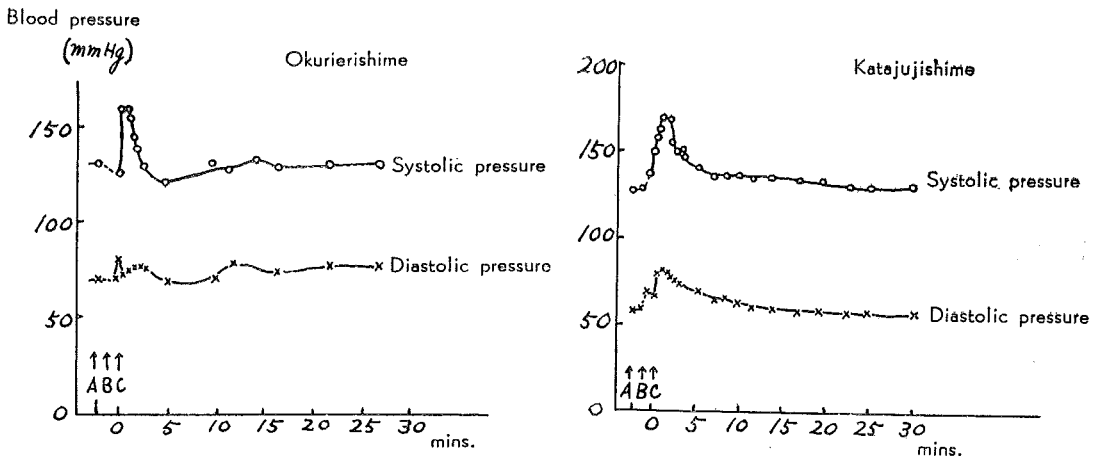


Fig. 3. Changes in blood pressure of defensive during "choking" technique, A, B, C represent the rest, "choking" and revival periods respectively.

(iii) Blood pressure before and after the match.—During a match, aside from the physical strain there is a mental strain, and as a result the effect on the blood pressure is expected to be different from that during an ordinary training exercise where there is practically no mental strain.

Seventy eight subjects ranging from 35 to 66 years in age, and all above the sixth grade were selected, and measurements were taken before and after the matches.

Before the matches in spite of the fact that there was no physical strain blood pressure readings registered higher than normal. Systolic pressure showed an increase of from 20 to 25 mmHg. (Table I).

Undoubtedly the preliminary light exercise taken before the match may be in part be

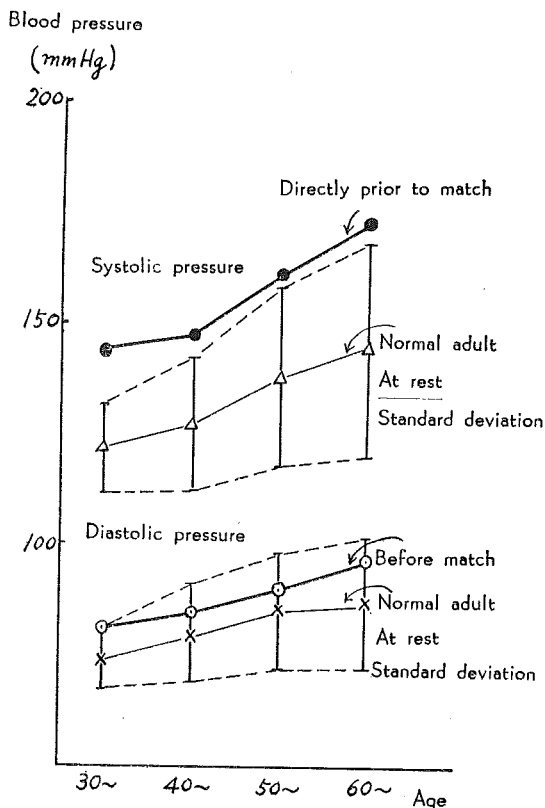


Fig. 4. This figure shows that the blood pressure prior to the match is higher than that at rest. The increase in the systolic pressure prior to the match is greater than the standard deviation of the systolic pressure at rest.

were taken two to three minutes after the conclusion of the matches, and it is presumed that the values directly after the matches are somewhat higher. Fig. 15 is a histogram of the blood before and after the matches. No marked changes may be observed in the systolic pressures, but the diastolic pressures clearly show a decrease after the matches. It is presumed that this decrease is due to the dilation of the peripheral vessels after the matches.

Among the high grade holders those above 50 years of age very often showed

Table 2. Example of hypertension (diastolic pressure mmHg)

subjects	before match	after match
1	194	256
2	181	182
3	200	150

Table 1. Increase in systolic pressure before the match

age	systolic pressure (mmHg)		
	at rest	before match	difference
30~39	125	144	19
40~49	130	147	17
50~	135	161	26

the cause of the above increase, however the effect of the mental strain prior to the match cannot be overlooked. As compared to the increase in systolic pressure the increase in diastolic pressure was only slight, causing an increase of approximately 15 mmHg in the pulse pressure. Fig. 4 shows the average blood pressure prior to the matches classified according to age, and compared to the average blood pressure at rest of normal healthy subjects of corresponding ages.

Blood pressure measurements taken after the matches showed lower values than those taken before the matches.

However, these measurements were not taken directly after the matches, but

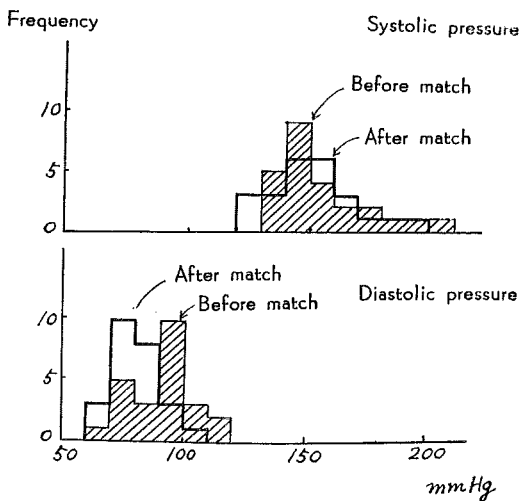


Fig. 5. Comparison of blood pressure before and after match.

high blood pressure readings (Table 2). However, even among those subjects with hypertension nothing unusual happened after the matches.

2) Permanent effect on blood pressure. It is expected that the circulatory system of high grade holders who had been practicing judo for a number of years would be influenced to some extent. In order to study the permanent effect of judo on the circulatory system, blood pressure measurements were taken at rest, and also the blood pressure regulating function investigated.

(i) Blood pressure at rest.—Blood pressure measurements were taken on some fifty high grade holders all above the sixth grade, ranging in age from forty to sixty years. The

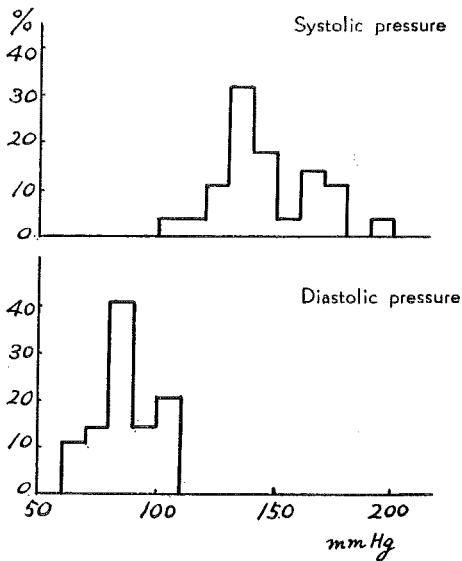


Fig. 6. Histogram of blood pressure at rest of high grade holders.

results are shown in Fig. 6. The mode of the systolic pressure is at 130 to 139 mmHg, and that of the diastolic pressure at 80 to 89 mmHg. The systolic pressures of approximately 60% of the subjects were between 120 and 150 mmHg and were within normal limits, but the systolic pressures of approximately 30% of the subjects were above 160 mmHg and may be classed as hypertensives.

From the above it has been found that the blood pressure values at rest of judo-men of over forty years of age do not differ greatly from those of ordinary people of corresponding ages (2), (10); also as the age increased there are quite a number of hypertension cases even among the judo experts.

(ii) Blood pressure regulating function. Blood pressure regulation is accomplished by the circulatory system and the autonomic nervous system controlling it. Since the blood pressure regulating function is a part of homeostasis of the body, investigations were made on the changes in blood pressure and their mode of returning to normal levels, when the subjects posture was changed from the supine position to the sitting position. To do this Fukuda's postural reflex method (4) was adopted. The subjects were made to sit on the posture changing chair, and after resting for approximately five minutes the right cubital blood pressure was measured at one minute intervals. When the readings became stabilized the value was fixed as that of the sitting position. Then the chair by means of the attached device was suddenly changed into the supine position. Two minutes later, in this position, blood pressure was again measured. This reading was fixed as the supine position value. Next the position was again suddenly changed into the sitting position. Blood pressure measurements were taken for three minutes at fifteen to thirty second intervals.

When the posture was suddenly changed from the supine position to the sitting position, the systolic pressure temporarily decreased after which it gradually resumed its normal level, in most cases within two minutes. However, in certain subjects this return to the normal level took longer than two minutes, in which case the blood pressure

Postural blood pressure reflex of judo-men

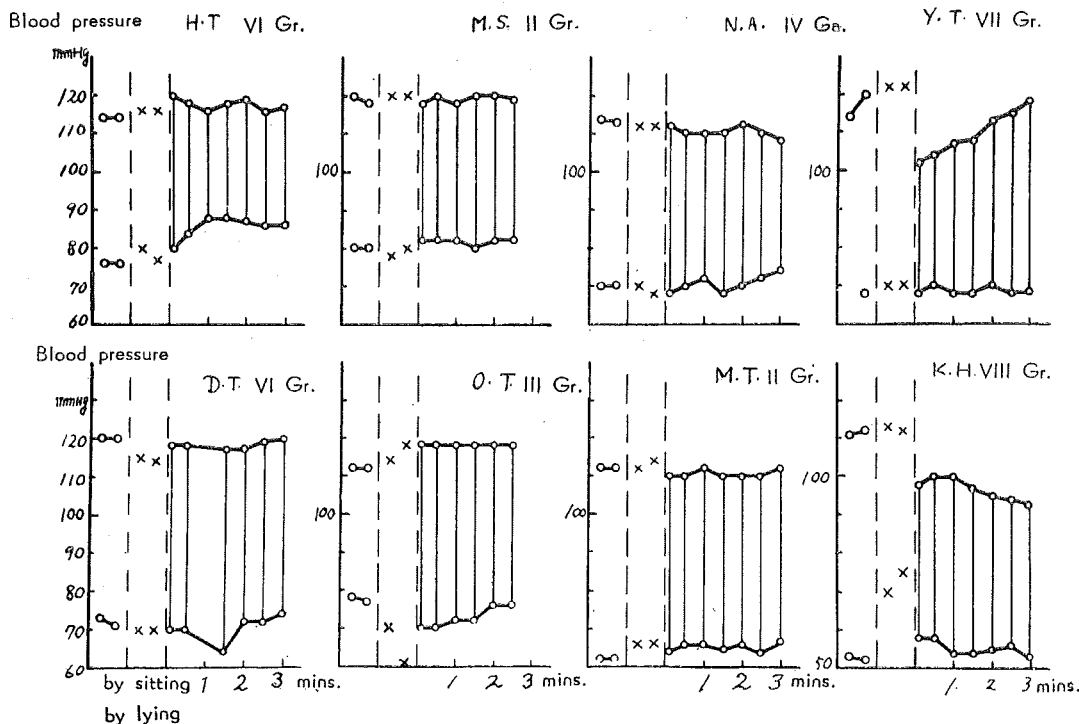


Fig. 7. Postural reflex of judo-men.

regulating function may be considered deteriorating. In those subjects with proper blood pressure regulating function the postural changes in blood pressure were only slight, and normal levels resumed within fifteen seconds. As shown in Fig. 7, the postural changes in blood pressure were very little and resumed normal values very quickly. The revival time of the blood pressure level to normal in the average healthy adult is approximately two minutes, whereas the average time in the present study was found to be approximately one minute. However, in the high grade holders of over sixty years of age the average revival time was longer than two minutes, and in spite of the judo training in the aged, the blood pressure regulating function showed a decline. From the above it is concluded that judo has a favourable effect on the blood pressure regulating function (Fig. 7):

### Discussion

An investigation on the effect of judo on the circulatory system, particularly on blood pressure is necessary as part of the scientific study of judo, and also for the preservation of health of those practicing judo.

The immediate effect of judo on blood pressure does not differ very much from that of other sports. However, the throwing technique and the "choking" technique are something quite different from other sports. The strain on the defensive in a throwing technique is in the form of an impact, and the response of the circulatory system when

such an impact is successively administered is quite worthy of note. The defensive when thrown down is in the defensive position and the condition is somewhat different from that of a falling body, however the body directly receives the impact when hitting the floor. This condition is somewhat similar to Goltz's tapping experiment. Goltz explained the inhibition in the pulse rate resulting from tapping the frog's abdomen thus: the mechanical stimulus of tapping excites the splanchnic nerve whose afferent fibres send impulses to the medulla, and there reflexly excites the vagus nerve, inhibiting the heart beat. It has been reported (1), (3) that in man a strong impact on the abdomen can cause death even without damage to the viscera. Ikai and Matsumoto (6) by means of cinematographic analysis have succeeded in calculating the force of impact upon hitting the floor when the defensive lands without putting himself in the defensive position. It was found that in the throwing technique, in general the impetus was from 130 to 518 kg.m/sec. In the hip technique it was approximately 300 kg.m/sec. The above impetus although slightly deadened by the proper defensive posture taken by the defensive, when administered successively for from ten to twenty times is liable to cause some form of cardiac reflex. Measurements were made with the expectation that such a reflex action would be elicited, but in most cases it was not observed.

However, in one young subject in the course of studying the changes in his pulse rate, it was observed that following the rise in pulse rate directly after the feat, a marked decrease occurred accompanied by arrhythmia. It was found later that the subject had been suffering from a slight cold during the performances. When the autonomic nervous system is slightly unstable as when the subject is suffering from a cold, the effect of the impact becomes more pronounced.

The changes in blood pressure of the defensive while he is being "choked" show an increase in pressure, regardless of the type of the technique used. It has been reported by Ikai et al (8) that during this stage an increase in the rate and also in the magnitude of heart beat (9) is found. This is accompanied by a contraction of the peripheral vessels of the skin (8). It is also recognized that during the stage of unconsciousness the subject is being asphyxiated, and clonic or tonic spasms appear. These factors contribute to the rise in blood pressure, hence a person with hypertension is exposed to the dangers of circulatory accidents if "choked". Since, during the unconscious stage there is a decrease in the rate of heart beat and also in the output of the heart (9), together with an increase in the blood flow through the muscles (8), a fall in blood pressure is expected. However, the measurement of blood pressure during this stage has not been successful.

The blood pressure at rest as an index of the permanent effect of judo showed no significant tendencies. There were subjects with hypertension among the aged judo-men, but even in these subjects no immediate ill effects of judo were recognized, indicating that in ordinary practice the physical strain sustained is within safe limits.

From the results obtained from measurements of postural changes in blood pressure, it may be concluded that the blood pressure regulating function of judo-men is superior to that of the average healthy adult. However, among the aged (over sixty years) high grade holders this function was found to be on the level with the average healthy adult, showing a slight deterioration due to age. Ikai (7) has already reported on the deterioration of the blood pressure regulating function due to age, and our present study proves that

judo-men are without exceptions.

### Conclusions

The immediate and temporary effect, together with the permanent effect of judo on the circulatory system, has been studied, and as a result the following has been made clear.

(1) The blood pressure at rest of high grade holders between forty and sixty years of age were identical to those of the average healthy person between those ages, however a few subjects among those over fifty years had hypertension.

(2) With these high grade holders no ill effects were recognized after a match, proving that the long practice of judo has trained them to avoid overstraining themselves.

(3) The blood pressure regulating function of judo-men were found to be superior to that of the average healthy adult. However, with the advance in age it showed a slight deterioration.

From the above it is concluded that as long as judo is practiced properly it imparts a favourable effect on the circulatory system, and even among those with hypertension due to age there is no recognizable danger.

This supports the view that judo, if practiced properly is a sport fitting both to the young as well as to the aged.

Finally, I would like to acknowledge my indebtedness to Mr. Risei Kano, President of the Kodokan, and to all the high grade holders for their continued assistance.

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