

Identification of judo contest from physiological viewpoint

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Summary

Introduction. The purpose of the research was to identify a judo contest from physiological point of view, based on examination of duration of sequences of activity and breaks within a great number of contests.

Material and methods. Time sequences of activity during judo contest were measured in seconds from command of the referee *hajime* to *matte* (soremade) in European Championships 1985 and 1986, World Cup 1986, Olympic Games 1988-1996, European Championships 1999 and Olympic Games 2008. Concentration of lactic acid in blood in third minute after completing the contest was measured in arterialized blood from a tip of the finger or the ear lap with enzymatic method (set of Boeringer tests) and acid-base balance with analyzer Corning 166 micro.

Results. Mean time of sequences of activity in a judo contest are within range of 18 to 25 seconds but breaks, about 10 seconds. High intensity intermittent short efforts during a judo contest cause that energy system of a competitor involves primarily anaerobic glycolytic systems, therefore training specificity is crucial in the adaptation of the system. The ability to recover quickly from anaerobic work is essential for competition success, since the total contest performed during a tournament may range from 5 to 8 matches. Then aerobic capacity of a judo competitor is higher than average to utilize quickly highly concentrated lactic acid in the judoka's blood.

Conclusions. During a judo contest an energy is mainly delivered from anaerobic glycolytic system of a competitor, though aerobic capacity of a judoka is higher than average to utilize quickly lactic acid concentrated in blood.

Introduction

Judo being a combat sport is based on direct encounter of two opponents [1]. Metabolic and physiological requirements of the contest depend on intensity of scoring and non-scoring attacks and sequences of time of activity and breaks during course of the contest.

Each judo contest either occurs in standing position, or ground situations depending on individual strategy and natural development of the match. It is worth mentioning that time of fighting in *katame-waza* (groundwork) is very short in comparison with *nage-waza* (standing position) and limited lately by regulations to make matches more spectacular.

To acknowledge the time structure of a judo contest, sequences of activity and breaks in matches during most prestigious championships were observed.

Material and methods

Time sequences of activity during judo contest were measured in seconds from command of the referee *hajime* to *matte*

(*soremade*). Time sequences of breaks during the contest were also measured in seconds from command of the referee *matte* to *hajime*. Sequences of activity and breaks during all the contests were registered in European Championships 1985 and 1986 and World Cup 1986 [2], Olympic Games 1988-1996 [3], European Championships 1999 [4] and Olympic Games 2008 [5].

Concentration of lactic acid in blood in third minute after completing the contest was measured in arterialized blood from a tip of the finger or the ear lap with enzymatic method (set of Boeringer tests) and acid-base balance with analyzer Corning 166 micro.

Results and Discussion

Mean time of the sequences of activity during both European Championships 1985, 1986 carried out about 24 s, and in World Cup 1986 nearly 26 s, while breaks 10 s and 11 s.

High standard deviations testify great variability of duration of activity and breaks in the contests (Tab. 1).

Researches conducted between years 1985 and 2009 indicate that sequences of time of activity in judo contests are

Tab. 1. Average time sequences of activity and breaks during the contests of both competitors in European Championships 1985 and 1986 and World Cup 1986 [6]

Variables	European Championships 1985, 1986	World Cup 1986	Medalists of European Champ. 85, 86	Medalists of World Cup 1986	Poles in European Championships 1985, 1986
Average time of breaks in s.	9.73	11.35	9.95	11.61	9.98
SDX	12.16	12.32	12.69	15.11	13.07
Average time of activity in s.	23.74	26.48	23.33	25.64	23.22
SDX	16.76	17.50	15.72	17.72	14.20
Proportion of Time of break to time activity	0.37	0.38	0.38	0.40	0.39

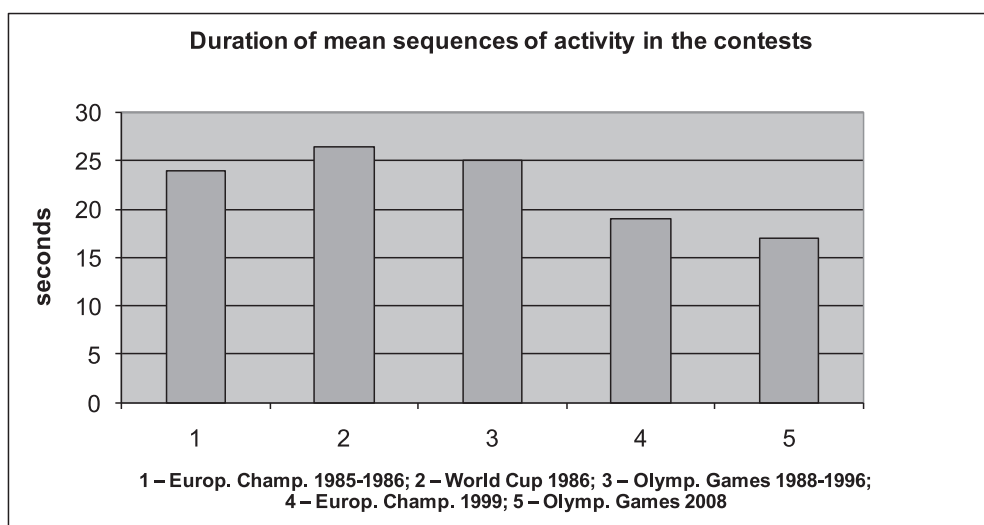


Fig. 1. Sequences of activity during judo contests in European Championships 1985 and 1986 (en block), World Cup 1986 [2], Olympic Games 1988-1996 (en block) [3], European Championships (1999) [4], Olympic Games [5]

gradually shortened while average time of breaks does not change [6], Fig. 1.

Categorizing periods of sequences of activity in the examined judo contests into four stages:

0-10 seconds, 11-20 seconds, 21-30 seconds and more than 30 seconds, the highest frequency of breaks (80%) in the range 0-10 seconds, and the highest frequency of activity in the second range 11-20 seconds (39%) [6]. Furthermore, it was found that mean time of work activity does not exceed 25 seconds with break periods mostly no longer than 10 seconds. Attacks are often initiated every 10 to 15 seconds of the contest [7].

Based on these findings, it can be concluded that the primary source of energy contribution in contest judo is derived from anaerobic glycolysis.

To prove the above thesis a level of concentration of lactic acid, hydrogen ions which causes pH blood to decrease, and acid-base balance were measured after terminating the contests in International Warsaw Tournament (1982), Tab. 2.

High value of La concentration in blood, low pH and high BE of the Polish competitors taking part in the Warsaw Tournament proved on one hand about high intensity of competitive effort, on the other, about good adaptation of the competitors working in metabolic acidosis, because all of them

Tab. 2. Values of lactic acid concentration, BE and pH measured after contests in the International Warsaw Tournament (1982) (Data from the Institute of Sport, Physiology Dpt – G. Mickiewicz [8])

Competitor	I contest			II contest			III contest			IV contest		
	pH	BE	LA	pH	BE	LA	pH	BE	LA	pH	BE	LA
1.	7.07	-21.1	18.0	-	-	-	7.3	-10.2	7.2	-	-	-
2.	6.98	-24.0	17.6	-	-	-	7.13	-17.8	13.0	7.19	-19.9	13.9
3.	6.92	-27.1	20.8	7.08	-21.4	14.6	7.25	-13.2	9.5	7.09	-20.8	14.6
4.	7.05	-21.9	17.4	7.1	-20.5	13.8	7.18	-16.6	15.8	7.17	-17.5	16.4
5.	7.17	-16.3	13.7	-	-	-	-	-	-	7.16	-17.1	15.1
6.	7.14	-18.3	15.3	-	-	-	-	-	-	-	-	-
7.	7.08	-21.5	19.4	7.08	-21.0	20.0	-	-	-	7.08	-20.6	20.0
8.	7.35	-8.6	6.75	-	-	-	7.3	-12.4	10.0	7.16	-18.7	14.6
9.	7.0	-25.0	17.8	-	-	-	-	-	-	-	-	-

Tab. 3. Values of LA concentration in blood of the competitors participating in the Polish championships and international tournaments from year 1981 to 1985 (Data from G. Mickiewicz researches in the Institute of Sport in Warsaw [9])

Analyzed parameters	Order of the contests					Finalists of Polish Champ. and international tournaments
	I	II	III	IV	V	
Number of contests n=130	n=51	n=15	n=22	n=5	n=15	n=22
LA mmol/l	13.90	14.93	13.15	13.34	13.16	13.60
SDX	2.89	2.40	2.45	1.04	1.63	2.35

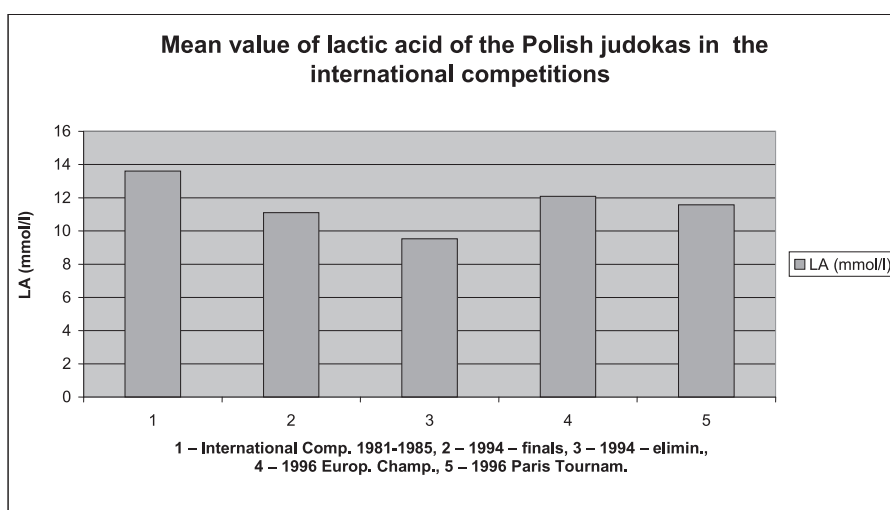


Fig. 2. Mean values of lactic acid concentration in blood of the Polish judokas participating in the international competition from 1981 to 1985 (en block); in the European Championships in 1994 (elimination contests and finals), in the European Championships in 1996 and in Paris Tournament in 1996 (Data Mickiewicz 1985 [9] and Blach 2005 [10])

Tab. 4. Values of concentration of lactic acid in 3rd and 30th minutes after contests in the International Warsaw Tournament in 1996 (Raport of the Institute of sport in Warsaw)

	I contest	30' later	II contest	30' later	III contest	30' later	IV contest	30' later	V contest	30' later
LA mmol/l	11.9	6.5	12.4	8.3	8.2	3.5	8.3	2.7	12.8	6.7
Duration of the contest	4'48"		8'03"		2'53"		5'35"		8'55"	
Time of contest	11:15		12:15		13:23		14:26		16:03	

(with one exception) won their matches and reached final. Most of the participants of that Warsaw Tournament (56%) were European, world championships and Olympic games medalists.

To get to know whether first or final matches are most demanding examined concentration of lactic acid in blood of the competitors participating in Polish championships and international tournaments from 1981 to 1985, [9], (Tab. 3).

Results of lactic acid concentration in blood of the competitors after terminating their matches lasting full time indicates that all the contests despite their order, cause profound homeostatic disturbance. 34 contests which were finished earlier were not taken into consideration. Mean value of lactic acid concentration in blood of the competitors was 13.73 mmol⁻¹ with low standard deviation. Thesis about hierarchy of the contests because of their order in tournaments has been not confirmed during the above researches. Such a conclusion has got practical application in preparation a competitor to tournaments. It means that each match demands from the athlete similar engagement of metabolic resources.

Similar but slightly lower concentration of lactic acid in blood of the competitors terminating their contests observed after finals in the European Championships in 1994, viz., LA=11.10 mmol⁻¹ (SDX – 2.01) and in the European Championships in 1996 viz., LA=12.9 mmol⁻¹, (SDX – 5.06) and in the International Tournament in Paris in 1996 viz., LA=11.57 mmol⁻¹ (SDX – 4.66), [10], (Fig. 2).

Although anaerobic lactate power is an essential component of judo physiology current literature indicates that VO₂ values of best competitors are higher than normal. Findings by Mickiewicz et al. 1987 revealed VO₂ values of elite senior judokas to be 60.22 l ml⁻¹.min⁻¹, Callister et al. [11] determined U.S male judokas to have a mean value of 55.6 VO₂ value ml⁻¹.min⁻¹. Canadian male judo athletes determined to have mean value of VO₂ 59.2 ml⁻¹.min⁻¹ [12].

Aerobic requirement of elite judo athletes is higher than average because it is needed for utilization of lactate between contests which sometimes follows one by one in shorter time than 30 minutes. If concentration of lactic acid after terminating the match is high, the competitor after the lapse of 30 min-

utes is not fully recovered and therefore nor ready to start a new contest (Tab. 4).

Conclusions

1. Judo contest consists of sequences of activity lasting mostly from 18 to 25 seconds and breaks lasting on average 10 seconds.

2. Because of intermittent efforts of high intensity a judo elite athletes engage in a contest mostly anaerobic glycolysis.
3. Higher than average aerobic power characterizes best judokas, because it helps them to utilize lactic acid between contests during the tournament.

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