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SELECTED COORDINATION FACTORS WHICH DIFFERENTIATE OLYMPIC TAEKWONDO ATHLETES WITH A MEDAL AND ATHLETES WITHOUT A MEDAL DEPENDING ON THE SPORT LEVEL

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Abstract: The aim of the research was to identify the factors which differentiate Olympic Taekwondo athletes in the junior and senior categories who win or do not win medals in the competitions in Poland. 127 Taekwondo athtletes took part in the research. They were divided into two research groups: the athletes who win medals and those who do not win medals in Olympic Taekwondo competitions in Poland. The results of the analysis showed that only one indicator of complex reaction time differentiated the athletes in the junior category who win and those who do not win medals in the competitions in Poland significantly. As for the senior category, any indicators of reaction time which significantly differentiate the athletes with and those without medals have not been noted.

Key words: Olympic Taekwondo, coordination, reaction time

Introduction

Olympic Taekwondo is a sport discipline where athletes face very high demands which are resulted from the nature of the fight and involvement of different parts of the body in changing conditions for sports rivalry caused by a competitor's behaviour.Therefore, the search for the factors which determine the achievement of high sport results increasingly included selected coordination motor skills i.e. reaction time.

A lot of researchers have studied the issue of reaction time conditioning on a sport result in taekwondo. Sadowski [1–3] presented interesting results of his research. He studied highy qualified taekwondo athletes in the junior and senior categories. According to his research, the athletes who present higher level of sport skills are characterized by better reaction time. The similar results were presented by Melhim [4] and Bujak [5]. They claimed that reaction time is an essential factor to obtain a high sport result in taekwondo both in the junior and senior categories.

In turn, Kwiatkowski [6] distingushed reaction time as a factor which differentiated the best and the weakest taekwondo competitors in the senior group. The competitors who had achievements in sport had significantly shorter reaction time from 5% to 15% in comparison with the rest of the respondents.

Vieten and his cooperators [7] also presented interesting results. They studied complex reaction time of upper and lower limbs of German taekwondo competitors.The respondents were divided into four groups: *the juniors of regional team, the seniors of regional team without sport results, the students and the seniors of the National German team.* It was estimated that reaction time of the athletes from the National team was significantly shorter than in the case of the juniors from a regional team. The athletes from the National team had shorter reaction time from 10% to 30% in comparison with the studied groups.

Ghorbanzadeh and his cooperators [8] compared the leading competitors of the National Turkish taekwondo team in the senior category with the group of so-called reserve athletes of the National team. The athletes of the National team had shorter reaction time, which differentiated the respondents from 5% to 8%.

The results mentioned above Sadowski [1], Sadowski and cooperators [2], Melhim [4], Sadowski [3], Bujak [5], Kwiatkowski [6], Vieten and cooperators [7] Ghorbanzadeh and cooperators [8] clearly demonstrate that short reaction time had an impact on the achievement of high results.

Olympic Taekwondo involves a high degree of movement complexity and high variability of sport competition. During the training competitors must master a lot of sensory and motor habits, technical or mental abilities in constantly changing situation of sports fighting if they want to achieve a high sport result.

As far as we are aware, up to now there has not been carried out any research related to the the factors which determine sport result in the junior and senior group using the same methods, techniques and research tools. Therefore, an attempt to identify these factors among athletes of

differentiated sport level with the use of the same research methods in every group was made.

Material and research methods

127 athletes of Olympic Taekwondo in the junior and senior categories from different sport clubs of Poland took part in the research. All the competitors took part in the system of sport competition run by Polish Olympic Taekwondo Association.

There were 63 (n=63) competitors in the junior category and 64 (n=64)competitors in the senior category. The sport level of a junior corresponds to the level of training from 6 kup to 1 dan and from 4 kup to 3dan for a senior. In both categories there were the competitors who win medals (the places 1-3) and those who do not win medals(the places 5-18). In this way four groups of the competitors were created; 27(n=27) juniors who win medals and 36(n=36) juniors without medals.

The data regarding to age and training state of the respondents are presented in Table 1.

Table 1: Age and training state of Olympic Taekwondo athletes (senior, junior).

No.	Group	Age $\overline{x}$	sd	Apprenticeship Training $\overline{x}$	sd
1	**Senior altogether**	**19,7**	**2,48**	**7,5**	**3,28**
	With a medal	19,7	2,41	8,3	2,75
	Without a medal	19,7	2,61	6,6	3,60
2	**Junior altogether**	**15,9**	**0,84**	**5,1**	**1,59**
	With a medal	15,7	0,85	5,5	1,94
	Without a medal	16,1	0,83	4,8	1,26

The resopondents took part in the programme organized training of Olympic Taekwondo. The juniors took part in a 90-minute training 5 times a week and the seniors had a 120-minute training 7 times a day.

All the respondents had current medical examination and confirmed their participation in the research in writing (in the case of the disabled the conirmation was signed by a parent or guardian). The research included the evaluation of simple and complex reaction time. A simple (A1, A2, A3) and complex reaction (B1, B2, B3) were measured by RT Test(S1 version) and DT (S1 version) according to the Vienna Test System [9]. The research was carried out in the Pshycomotor laboratory of the Institute of Physical Education and Sport in BiaĹ‚a Podlaska Academy of Physical Education in Warsaw:

Simple reaction (RT Test, S1 version)

An athlete was sitting opposite a monitor holding his finger of an upper dominating limb (right or left) on a rest key of the control panel (without forearm support). Having noticed a visual incentive he presses a key as soon as possible with his finger. The sum of the three simple reactions gave the result:

A1 – the median fast reaction time (the time interval between the beginning of the incentive and pressing a key expressed in ms),
A2 – the median sensor reaction time (the time interval between an incentive and releasing rest key expressed in ms),
A3 – the median motion time (the time interval between releasing rest key and pressing reaction key expressed in ms).

Complex reaction (DT Test, S1 version)

An athlete was sitting in front of the monitor and responded visual incentives which appeared on the monitor with both upper and lower limbs as soon as possible. Five incentives were appearing on the monitor. They had the shape of optical circles in white, yellow, blue, green and red colours. Five colour lamp were assigned to five appropriate reaction keys pressed by an athlete's right or left upper limb. White rectangular lamps on the black background required pressing right or left pedal with a lower limb.There were also acoustic incentives (high and low) which were assigned to white rectangular keys(the reaction with one or two limbs). The sum of the three complex reactions gave the result:

B1 – the number of correct reactions (number),
B2 – the number of wrong and omitted reactions (number),
B3 – the median reaction time(s).

The point classification of the Polsih Olympic Taekwondo Association was used to assess sports achievements [10]. The competitors were given an appropriate number of points depending on the place in the competitions. The sports achievements from two tournaments (two qualification tournaments to the Polsish National Championship and the Finals of Polish Olympic Taekwondo Championship) were taken into consideration. The point classification in the championship was presented in Table 2.

A review of data analysis was done and basic characteristics such as arythmetic means, standard deviation, volatility indicators and Pearson correlation coefficient were worked out [11–13].

Table 2: The point classification in the championship organised by the Polish Olympic Taekwondo Association.

The place in the competition	Polish Championship in Olympic Taekwondo	I st Qualification Tournament to Polish Championship	II nd Qualification Tournament to Polish Championship
I	25	3	3
II	21	2	2
III-IV	17	1	1
V-VIII	11	-	-

The results of the research

As a first step, the differences in simple (A1, A2, A3) and complex reactions (B1, B2, B3) between the respondents in the age category of different sport levels (junior, senior) were examined. The results are presented in Table 3.

Table 3: Differences of respondents' reaction time indicators in the junior and senior categories.

Indicator	Junior (J)		Senior (S)		Level of significance p
	$\overline{x}$	sd	$\overline{x}$	sd	J-S
Simple reaction A1 (ms)	258,65	34,81	243,25	29,75	***
Simple reaction A2 (ms)	128,44	35,37	106,61	25,63	***
Simple reactionA3 (ms)	387,10	60,07	349,86	43,99	***
Complex reaction B1 (number)	242,27	57,58	239,36	35,60	NS
Complex reaction B2 (number)	50,60	13,20	47,47	15,65	NS
Complex reaction B3 (s)	0,77	0,06	0,74	0,05	***

* p<0,05 **p<0,01 ***p<0,001 NS – not statistically essential (p>0,05)

The seniors had better values of four reaction time indicators (A1, A2, A3, B3). They were statistically essential (p¡0,001) in comparison with the juniors. The seniors achieved better results from 4% to 26% (Table 3).

Next indicators of reaction time of the respondents with and without a medal of the Polish Championships in the junior and senior categories were analyzed. The results are presented in Tables 4 and 5.

Only one indicator which differentiates significantly in the group of the respondents with and without a medal was noted. It was the indicator of complex reaction (B3). The respondents with a medal were characterized by a 5,3% shorter complex reaction time (p<0,016) in comparison with the respondents without a medal. Simple reaction time A3 was close to the level of significance. Other results varied, however it was difficult to indicate the dominance of any groups. It should be noted that there is a high diversity in the results in the senior group (Table 4).

In the senior category any indicators of reaction time which significantly differentiated the respondents with a medal and those without a medal was not noted. The vast majority of athletes with a medal achieved better results in most indicators.There was a worse result only in the indicator of a complex reaction B2 (Table 5).

Discussion and conclusions

The aim of the research was to identify selected factors which differentiate Olympic Taekwondo athletes with and those without medals in the competitions in Poland depending on a sport level (junior, senior). Existing reseach concentrated, first of all, on searching for the determinants of sporting success in body build [14–17] motor [18–20], technical [8, 14, 21] or psychical [15, 22, 23] preparations. Highly qualified competitors in the senior category were normally studied.. As for juniors, there were only occasional attemps of conducting research.

The differences in simple (A1, A2, A3) and complex reaction time (B1, B2, B3) taking into account the age category (junior, senior) without a division into the athletes with a medal and those without a medal of the Polish championships were examined first. The seniors obtained better values of the indicators of reaction time in four indicators (A1, A2, A3, B3). They were statistically essential in comparison with the athletes in the junior category. They achieved better results from 4% to 26%. Occuring differences likely to be associated with apprenticeship training, training process and the respondents' age differences.

Next the indicators of simple and complex reaction time of the respondents with a medal and those without a medal of Polish championship in the junior and senior categories were analyzed.

The juniors who win medals had a different indicator of reaction time (B3) in comparison with those athletes who do not win medals. The competitors with medals had shorter by 5% reaction time in comparison with the group without medals. The other indicators were better from 10% to 15% in comparison with other results, but they were not statistically essential.

Bujak [5] noted shorter reaction tme in the case of the taekwondo juniors who had the best sport results. Douris [24] also noticed that reaction time is one of the most essential factors that differentiate a sport result in the case of highly qualified juniors. The competitors with medals had shorter simple and complex reaction time.

The competitors from the senior group with medals and those without medals were not statistically different as for

Table 4: Indicators of reaction time of the respondents with and without a medal in the junior category.

Group Indicator	Respondents with a medal (n=27)			Respondents without a medal (n=36)			Level of significance
	$\overline{x}$	sd	CV %	$\overline{x}$	sd	CV %	p
Simple reaction A1 (ms)	254,07	32,98	12,98	262,08	36,19	13,81	0,370
Simple reaction A2 (ms)	128,07	31,57	24,65	128,72	38,41	29,84	0,943
Simple reaction A3 (ms)	382,15	57,51	15,05	390,81	62,41	15,97	0,052
Complex reaction B1 (number)	226,07	31,02	13,72	254,42	69,31	27,24	0,203
Complex reaction B2 (number)	47,48	10,09	21,25	52,94	14,83	28,01	0,285
Complex reaction B3 (s)	**0,75**	**0,06**	**8,00**	**0,79**	**0,06**	**7,59**	**0,016**

* p<0,05 **p<0,01 ***p<0,001 NS - not statistically essential n(p>0,05)

Table 5: Indicators of reaction time of the respondents with and without medals in the senior category.

Group Indicator	Respondents with a medal (n=28)			Respondents without a medal (n=36)			Level of significance
	$\overline{x}$	sd	CV %	$\overline{x}$	sd	CV %	p
Simple reaction A1 (ms)	238,40	26,74	11,22	247,03	31,74	12,85	0,253
Simple reaction A2 (ms)	104,54	29,55	28,27	108,21	22,44	20,74	0,574
Simple reaction A3 (ms)	342,93	46,38	13,52	355,97	41,49	11,66	0,261
Complex reaction B1 (number)	243,51	38,55	15,83	235,71	32,93	13,97	0,529
Complex reaction B2 (number)	49,40	15,37	31,11	45,76	15,92	34,79	0,525
Complex reaction B3 (s)	0,74	0,05	6,76	0,75	0,05	6,67	0,378

* p<0,05 **p<0,01 ***p<0,001 NS – not statistically essential (p>0,05)

the speed of reaction. The results of the research concerning simple and complex reaction time were noted on the middle level according to the Bołoban scale [25].

In turn, Melhim [4], Kwiatkowski [6] and Ghorbanzadeh and his cooperators [8] presented different results. They noted that taekwondo competitors in the senior category who had sport success had shorter simple and complex reaction time.

Heller and his cooperators [26] and Abdossaleh with his cooperators [21] claimed that the taekwondo seniors with sport success are characterized by shorter reaction time in comparison with the competitors without any success. Shorter reaction time correlates strongly with sport success. Vieten and his cooperators [7] came to similar conclusion. They claimed that shorter complex reaction time is the essential factor that differentiate a sport result in the case of highly qualified taekwondo competitors from Germany.

Sadowski and his cooperators [2], confirmed this thesis in their research. They identified the ability to react quickly as the factors which differentiate highly qualified taekwondo competitors in the senior category. Essential correlation between reaction time and sport result was not identified in the research. It is probably due to the fact that both seniors with medals and those without medals obtained similar values of these parameters.

In the earlier stages of ontogeny reaction time shortens significantly followed by stabilization and a gradual regress with age [27]. The influence of sport activity on the process of shortening reaction time seems to be debatable [28]. Some authors believe that specialized training causes the shortening of reaction time [29, 30], others think that sport training does not influence reaction time significantly [31]. In turn, Szopa and Mleczko [27] claim that reaction time is genetically conditioned to a large extent. This is the reason why the changes from the impact of external factors can be insignificant.This perhaps explains the lack of differences in reaction time of the competitors in the senior category.

The analysis of the indicators of taekwondo competitors' reaction time in the junior category revealed statistical differences between the competitors with medals and those without medals. It turned out that the indicator of complex reaction time significantly differentiated the study group. Any essential differences between the competitors with medals and those without medals were not noted in the senior group.

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