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Usability of non-apparatus and quasi apparatus flexibility tests based on self-perception participants in health-related judo training

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

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Abstract

Background & Study Aim: In training practice, too little attention is paid to association between objective indicators of phenomena, which measures incentives and training effects with subjective sensations of trained persons. The aim of this study is knowledge about relationships between subjective feelings of athletes use different non-apparatus and quasi apparatus flexibility tests and objective results of this tests in three situations judo training.

Materials & Methods: Eight male subjects were examined during 3 judo recreation training sessions: age ranged from 18 to 43 years (mean 28.8 ±8.5); training experience ranged from 0.5 to 3 years (mean 1.4 year). In assessment, three flexibility tests were used each time in three different training situations, switching the order of their usage: FED, SABS, SASRT. For evaluation of their opinion about test, they were asked to put scores ranged from 1 to 5 for five indicators (feature's rating): F1 – comfort of test; F2 – perception of security; F3 – compatibility with own perception of flexibility; F4 – precision of assessment; F5 – toleration of negative feelings from different parts of body.

Results: Only SASRT's (*self-assessment sit reach test)* test where rated lowest ratings had significant correlations between two features and resting state of the body. Especially indicators F2 and F4 during assessment SASRT and SABS (*modified measurement of finger-floor distance – self-assessment Bending scale)* suggests relations between subjective discomfort sensations of training participants with real state of body stimulation and generating unwanted muscle stiffness during exercises for specific training session stage.

Conclusion: Simultaneous application of SASRT and self-perception scale are simple tools for diagnosing flexibility in different states of body stimulation and direct assumptions about generating unwanted muscle stiffness during exercises (*randori*) before assessment.

Key words: extreme effort • flexibility level • intensity zones • motor safety • randori

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Ukemi – various falling techniques learned in martial arts for judo or aikido.

Uchikomi – a term referred to the repeated practice of a throwing motion up to the point where the throw would actually be executed (the simulation stops at that point).

Randori – a free sparring drill which allows both practice partners to execute *waza*. Randori is a fundamental judo drill in which a combatant uses *waza* which have polished in *uchikomi* (repetition training) and *yakusoku geiko* (agreed-upon practice), to attack and throw the practice partner in a manner which simulates an actual contest.

Ne-waza – to fight in horizontal posture, including kneeling and supporting on forearms

INTRODUCTION

In training practice, too little attention is paid to association between objective indicators of phenomena, which measures incentives and training effects with subjective sensations of trained persons. Although there are connections between cognitive sphere and physical activity [1], no specific studies about relations between mental imagery of one's own motor abilities with objective measurements of those indicators for professional combat sports athletes could be found. Value of subjective assessment of positive health indicators and survival abilities was shown in health-related training studies [2]. Couple of studies showed connection between health-related training and development of motor competences since childhood [3]. There were also studies that showed correlation between level of flexibility and motor competences among children [4]. Proper motor competences allow to undertake adequate action in specific situations, such as threat or sport combat [5].

Development of self-consciousness of one's own motor abilities in judo is given away its place for studies focused on other aspect of mental preparation to sport combat. However, mental sphere studies are focused only on better ways to achieving desirable results during competitions.

Mental preparation of person that train judo is focused on improving concentration before a fight, because attention level is connected with result of sport confrontation [6]. Another aspect of mental development is motor imagery of move, that will be performed [7]. Psycho-neuro-muscular theory assumes, that during motor imagery, there is similar muscle activity as when movement is normally performed. In judo training, proper imagination of technique, that is going to be executed is strengthening muscle memory and allow better real execution of technique because of muscle memory improvement [8]. There is significant relationship between motor imagery and real performing [9,10]. This technique seems to have connection with self-perception of one's own motor abilities. If training person will imagine performing some movement without real motor preparation to its execution, it will end up failing. Unfortunately, there are no reports about relations between objective indicators of motor abilities with mental imagery of movement.

Proper psychological preparation to undertake various motor activities is connected with reduction of susceptibility of body injuries [11]. Therefore, proper monitoring of psychological indicators, including self-consciousness coaches of own abilities is important task for coaches and therapists conducting health-related training or preparation for sport competitions [12].

This study is continuation of flexibility assessment of group of judokas by using quasi-apparatus and non-apparatus flexibility tests [13]. Frame of studies exceeded motor aspect, so subjective assessment of usability of applied test was presented in separate paper.

The aim of this study is knowledge about relationships between subjective feelings of athletes use different non-apparatus and quasi apparatus flexibility tests and objective results of this tests in three situations judo training.

MATERIAL AND METHODS

Participants

Eight male subjects who are attending to judo recreation training sessions (as a form of health-related training) in Student's Sport Section in Academy of Physical Education in Katowice in Poland were examined. Their age ranged from 18 to 43 years (mean 28.8 ±8.5) and their training experience ranged from 0.5 to 3 years (mean 1.4 year).

The study was conducted within the research project Academy of Physical Education in Katowice: "Reducing vulnerability to body injuries during the fall of people categorized as group being at high risk of losing balance and falling" (Resolution No. 04/2013 Bioethics Committee at the Jerzy Kukuczka Academy of Physical Education, Katowice, Poland).

Methods and protocols

Flexibility assessment – three tests measuring flexibility of spine and hamstrings muscles

In assessment, three flexibility tests were used each time in three different training situations, switching the order of their usage: *forward bending test – finger-floor distance (FFD)* [14]*; modified measurement of finger-floor distance – self-assessment Bending scale (SABS)* [15]*; self-assessment sit reach test (SASRT)* [16].

Method of flexibility assessment using applied tests, as well as method of heart rate measurement and determination of intensity zones of physical effort were described in previous paper, which concerned another aspect of study on the same group and

training sessions [13]. Results of flexibility assessment, as well as content of training sessions were documented according to Protocol Continuous Workload with Variable Intensity [17].

Method of subjective assessment of applied flexibility tests

For subjective assessment of applied flexibility tests, special questionnaire was adopted. In this questionnaire, tested persons were asked to put score (from 1 to 5, where 5 is highest desirable value) for five indicators: F1 – comfort of test; F2 – perception of security; F3 – compatibility with own perception of flexibility; F4 – precision of assessment; F5 – toleration of negative feelings from different parts of body.

Tested persons filled specific parts of questionnaire after every application of one flexibility tests for every measurement's situation, without inspection of scores, that were put earlier.

Statistical analysis

There were only eight tested persons, which makes sample size too low to assume, that variables are distributed normally. Therefore, apart from common statistical calculations such as mean, non-parametric test for depended variables (Friedman's ANOVA and Wilcoxon's test) were computed. To determine correlation between variables, Spearman's test was used. Level of statistical significance were assumed at $p<0.05$.

RESULTS

1. Overall result of subjective assessment of applied flexibility tests

The highest rate among all applied tests were given to modified finger-floor distance test (SABS), with mean value of all indicators for all applications of 4.51. The lowest rate was given to self-assessment sit reach test (SASRT) with mean value of 4.36 (Figure 1). Statistically significant difference between mean values concerns only SABS and SASRT ($p<0.01$).

2. Mean values of indicators of subjective assessment of applied flexibility tests in various measurement situations

Values of respective indicators were higher in case of subjective assessment of finger-floor distance test (FFD) in measurement situation B (after 30 minutes of exercises) than in situation A (in the state of rest). One exception was indicator F4 (precision of assessment), which mean value was decreasing in every following diagnostic situation (from 4.83 in A to 4.54 in C). After the end of exercises (situation C), apart from indicator F3 (compatibility with own perception of flexibility), which value increased from 4.17 to 4.46, other indicator's values decreased (Figure 2).

Under subjective assessment of SABS test, values of indicators F1 and F5 are higher in situation B than in situation A. Overall mean value of all indicators in situation A and B was similar (4.62 and 4.63 respectively). In situation C this value was lower (4.28).

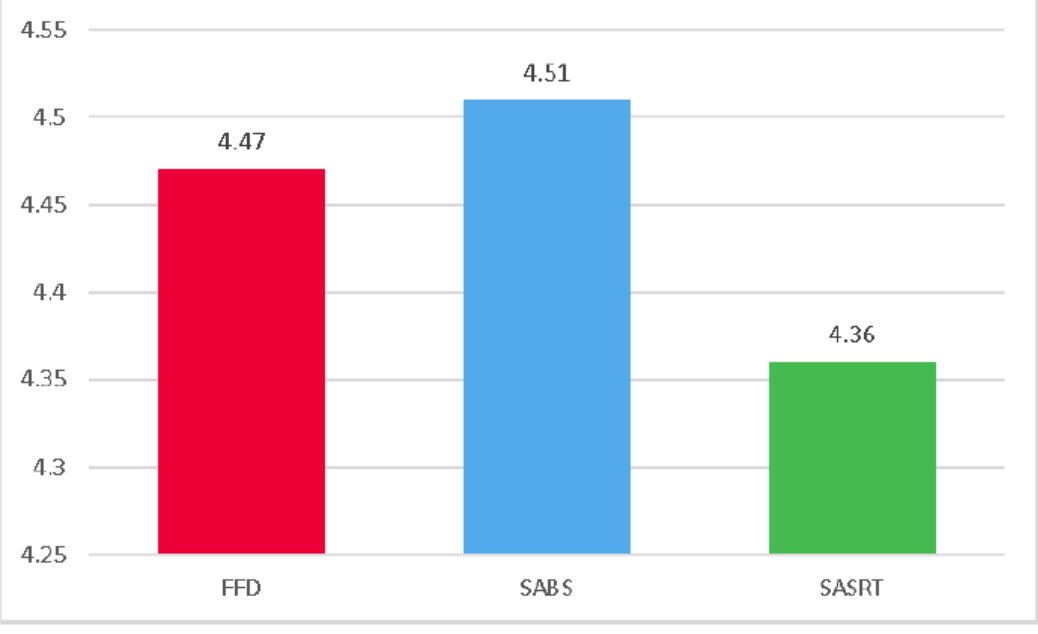
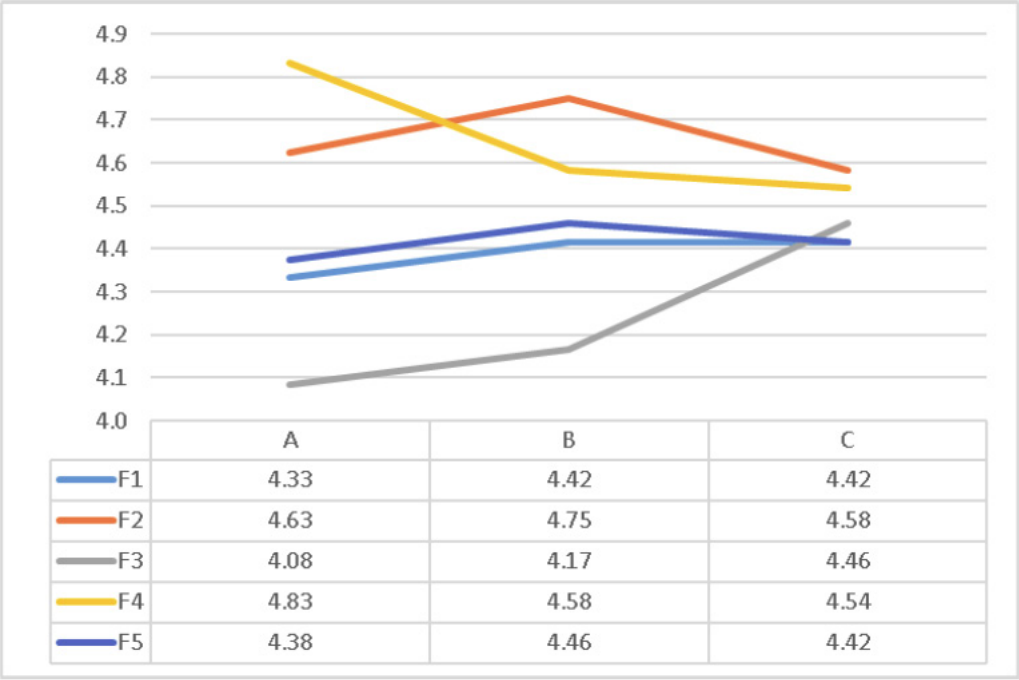


Figure 1. Overall mean value of feature's ratings for three applied flexibility tests (in 5 points self-perception scale).



	A	B	C
F1	4.33	4.42	4.42
F2	4.63	4.75	4.58
F3	4.08	4.17	4.46
F4	4.83	4.58	4.54
F5	4.38	4.46	4.42

Figure 2. Mean values of feature's rating for different states of body stimulation for FFD test (in 5 points self-perception scale).

Highest decrease of mean value pertains to indicator F1 (comfort of test): from 4.79 in situation B to 4.38 in situation C and F5 (toleration of negative feelings from different parts of body) from 4.54 in situation B to 3.79 in situation C (Figure 3).

All indicators of subjective assessment of application of self-assessment sit reach test (SASRT) are higher in situation B (4.63) than in situation A (4.24). In situation C, all mean values of indicators decreased with highest decrease of value of indicator F5 form 4.50 in situation B to 3.67 in situation C (Figure 4).

3. Differences between mean values of respective indicators of subjective assessment related to respective measurement situations and training sessions

Only in situation C (after the end of exercises) statistically significant difference were shown among mean values of F1 (comfort of test) indicator for respective training sessions ($p<0.002$) (Table 1).

Within the aggregation of relation came around respective training sessions, scores given to FFD test made the most statistically significant differences. In third training session (T3) none of significant difference were shown between values. In assessment of SABS there was only one statistically significant difference between respective situations in T1 for indicator F5. In assessment of SASRT there was only one statistically significant difference between respective situation in T3 for indicator F4 (Table 2).

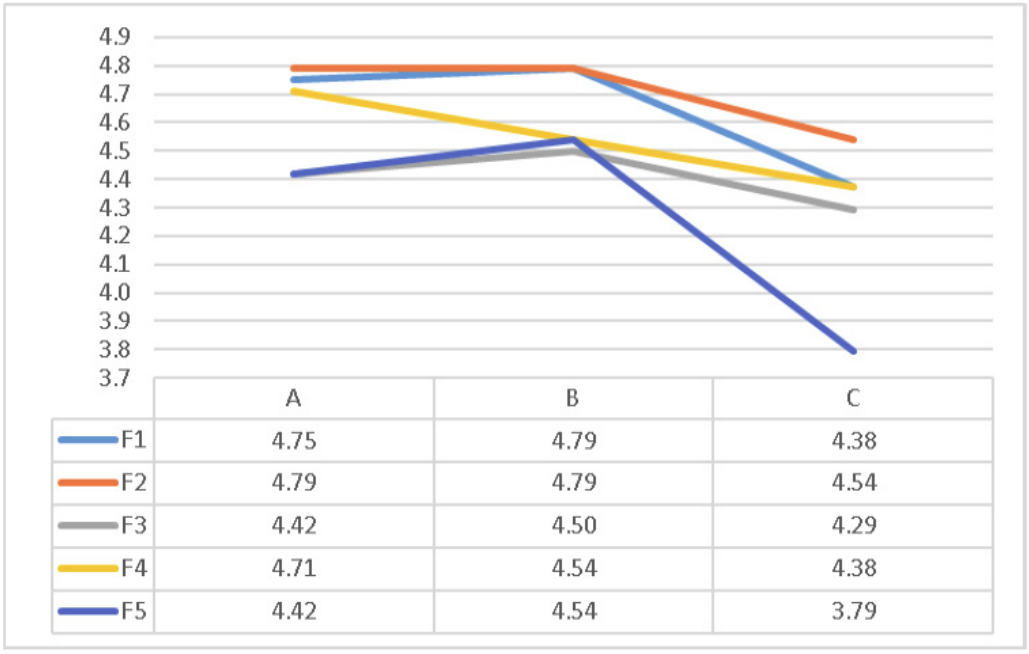
4. Relations between subjective assessment of flexibility tests and objective measurement indicators

There was none statistically significant correlation between given scores for respective indicators and intensity of exercises in respective situations for none of flexibility tests.

There were two moderate positive correlations between indicators F2 and F4 and results of SASRT ($r = 0.551$ and 0.425 respectively) in situation A. There was also one moderate negative correlation between indicator F3 and result of SABS test ($r= –0.532$) in situation A (Table 3).

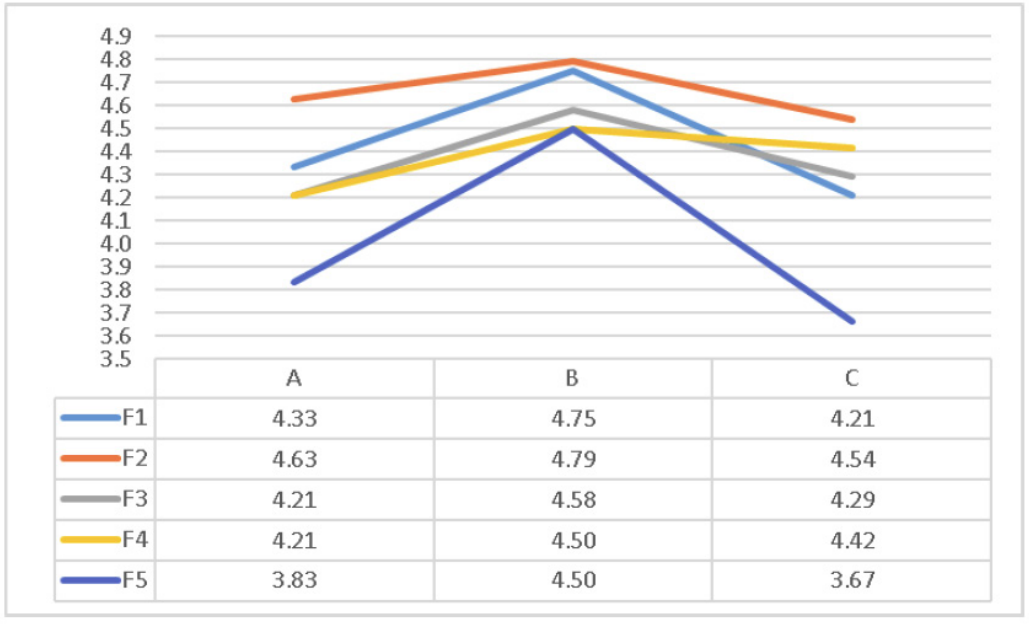
DISCUSSION

this was first time when this original questionnaire of self-perception of flexibility tests was used during three observed judo training sessions. Therefore, gained results cannot be compared to other studies. Although application of questionnaire was supposed to extend the knowledge about usability of



	A	B	C
F1	4.75	4.79	4.38
F2	4.79	4.79	4.54
F3	4.42	4.50	4.29
F4	4.71	4.54	4.38
F5	4.42	4.54	3.79

Figure 3. Mean values of feature's rating for different states of body stimulation for SABS (in 5 points self-perception scale).



	A	B	C
F1	4.33	4.75	4.21
F2	4.63	4.79	4.54
F3	4.21	4.58	4.29
F4	4.21	4.50	4.42
F5	3.83	4.50	3.67

Figure 4. Mean values of feature's rating for different states of body stimulation for SASRT test (in 5 points self-perception scale).

non-apparatus and quasi apparatus flexibility tests during health-related training [13] (judo is one of possible application), this questionnaire of self-perception is worthy to be discussed.

There are obvious reasons for lack of correlation between five indicators of self-perception (feature's rating) and intensity of exercises (this is technical term is referring to state of body stimulation in specific training situations). Small sample is not the only reason. Five self-perception indicators is referring to a wide sphere of subjective feeling (associated with experience of pain, necessity of consideration about compatibility of self-evaluation of flexibility with objective result of test etc.). It concerns physiological, psychological or intellectual (cognitive) basis of

Table 1. Results of Friedman's ANOVA analysis for differences between rated features in the same situations (SIT) in-between three training sessions (significant differences for p<0.05 are bolded).

SIT	Test	Rated features				
		F1	F2	F3	F4	F5
	FFD	0.449	0.818	0.311	0.367	0.645
A	SABS	0.368	0.264	0.778	0.717	0.143
	SASRT	0.861	–	0.735	0.099	0.838
	FFD	0.606	0.092	0.074	0.105	0.485
B	SABS	0.367	0.173	0.472	0.367	0.449
	SASRT	0.810	0.472	0.860	0.645	0.735
	FFD	0.606	0.449	0.42	0.818	0.925
C	SABS	**0.002**	0.772	0.925	0.645	0.069
	SASRT	0.443	0.790	0.704	0.939	0.529

Table 2. Results of Friedman's ANOVA analysis for differences between rated features on the same training in-between three different states of body stimulation (significant differences for p<0.05 are bolded).

Training	Test	Rated features				
		F1	F2	F3	F4	F5
	FFD	**0.049**	0.135	0.246	0.038	0.049
T1	SABS	0.223	0.201	0.716	0.367	0.015
	SASRT	0.367	0.778	0.778	0.173	0.074
	FFD	0.367	0.096	**0.038**	0.424	–
T2	SABS	0.223	0.135	0.716	0.548	0.223
	SASRT	0.367	0.472	0.881	0.778	0.263
	FFD	0.716	0.716	0.331	0.165	0.472
T3	SABS	0.105	0.778	0.246	0.165	0.716
	SASRT	0.135	0.135	0.496	**0.024**	0.144

those feelings, so it is hard to expect some common link, which might explain clearly these connections. Furthermore, state of body stimulation is measured in %HRmax, which makes intensity zones so wide, that results of individual measurements is placing all tested persons in the same zone of physiological stimulation of the body (with exclusion of heart rate, which might be mapping emotions). The comment in bracket is important. In case of this study, it is certain, that HR value is corresponding with physiological state of body stimulation, which was representing state of the body before training session (situation A), after 30 minutes of exercises (B) and after the end of exercises (C).

Considering correlations between self-perception indicators and flexibility test results, analogy of reasoning about this relation is justified only partially (Table 3). When the body was not stimulated by exercises (situation A), only in two cases for application of SASRT, positive significant correlations were shown: for F2, perception of security (r = 0.551) and F4, precision of assessment (r = 0.425). Both results can be explained by associating subjective feelings with self-consciousness of motor abilities, which are determined by state of physiological stimulation of the body paired with exposition of flexibility in situation forced by test followed by acceptance of objective result with self-evaluation of own possibilities in those situations.

Table 3. Results of Spearman's correlations between objective measurements (HR values and flexibility test results) and rated subjective features in three different situations (SIT) (significant values for p<0.05 are bolded).

SIT	Rated feature	Intensity of exercises (%HRmax)			Flexibility test result		
		FFD	SABS	SASRT	FFD	SABS	SASRT
A	F1	–0.011	–0.097	0.177	0.116	–0.161	0.154
	F2	–0.210	–0.041	0.401	–0.079	–0.327	**0.551**
	F3	–0.326	–0.214	0.178	–0.006	**–0.532**	0.394
	F4	0.006	–0.099	0.400	0.066	–0.154	**0.425**
	F5	–0.024	–0.121	–0.045	0.393	–0.191	0.067
B	F1	0.025	0.104	0.078	0.108	–0.016	0.080
	F2	0.207	0.402	0.278	0.180	0.331	0.127
	F3	0.261	0.188	0.286	–0.037	–0.361	0.159
	F4	0.255	–0.010	0.154	0.114	–0.283	0.394
	F5	0.121	–0.068	0.345	0.269	–0.088	–0.048
C	F1	0.309	0.209	–0.020	0.206	0.023	0.155
	F2	0.126	–0.038	–0.164	0.264	–0.364	0.094
	F3	0.246	0.128	0.095	0.152	0.004	0.200
	F4	0.082	0.189	0.204	–0.072	0.158	0.323
	F5	0.075	0.174	–0.073	0.228	–0.165	–0.157

Characteristically, in this situations all correlations referring to SASRT are positive, and those referring to SABS are negative (FFD results are mixed and all statistically insignificant). In case of SABS, there was one statistically significant negative correlation for F3 – compatibility with own perception of flexibility (r = 0.532). This is exactly opposite to application of SASRT (r = 0.394). Although this correlation is insignificant, it is harmonized with interpretation of correlation between test results and indicators F2 and F4 (it fulfills it).

When the body is stimulated by exercises to a level of high intensity zone, all correlations fades away. It is natural. The main reason is that discomfort with accompany almost all recommended flexibility tests is reduced. The biggest discomfort is in situation, when the body is not stimulated above the physiological state necessary for normal daily activity.

Therefore, only during assessment using SASRT this discomfort can be identified to some degree. This is not merit of this test alone. Simultaneous usage of self-perception questionnaire is necessary. This essential methodic intervention does not change the fact, that it is right to recommend SASRT as the most prognostic application in training and therapeutic practice, because it not only fulfills criteria of validity and reliability, but also it is the safest applied test [13].

The fact, that during application of SASRT in every situation, indicator F5 was rated the lowest, did not affect its recommendation. It is necessary to take to account, that in practical application of tests, among all subjective feelings, toleration of negative feelings from different parts of body will be discomfort factor. Similar regularity is present during assessment using SABS.

Direct question about sense of comfort of tests (F1), seemingly testifies, that SABS is the only test in standing posture, which fulfill highest standard in that manner. It is true in situation A and B. After the end of exercises, self-evaluation is strongly decreased. Moreover, there is lack of similarity between mean values of F1 with indicator F5 (toleration of negative feelings from different parts of body), although similarities of indicator's values in relation "highest – lowest" in situation order A, B, C are overlapped. In case of FFD test, both types of similarities are the most compatible. Therefore, FFD should be

recognized as most comfortable among those tests. Visualization of those similarities and conclusions are possible by data presentation on Figures 2 to 4.

SASRT is performed in sitting posture and width of own fingers are used to determine result of measurement. For tested persons, this way of measurement is completely new. Although sitting posture is more safe during conducting assessment, tested men did not recognize this value on the same level as during assessment of FFD test. Exception is situation B, where F1 indicator was rated higher by 0.33 point in favor to SASRT, and indicator F5 was rated higher by 0.08 point.

Undoubtedly, sitting posture is making impossible to compensate negative feelings during assessment by minimal knee flexion. It is easier to take advantage of this possibility in standing posture of SABS, which were shown by higher indicators rating of F1 and F5 in regard to others. Despite that, there is lack of this explicitness in situation C. When this detail is associated with content of exercises before assessment C leads to interesting finding, which justify following explanatory hypothesis.

For the ending of each training session, tested judokas were performing two training fights (*randori*) in horizontal posture (*ne-waza*), 5 minutes each, separate by short break. Taking to account their low sport experience level, it is eligible conclusion, that during fights with conditions of limited possibility of movement, they generate many unnecessary muscle contractions that last from few to several seconds (e.g. while being pressed down to the mat, they were trying to regain more freedom of movement by general exposition of muscle strength, without using their yielding ability to differentiate muscle tonicity – aspect of effective technique and fight). Since the muscles were left without the possibility to stretch freely for more than 10 minutes (opposite to warm-up part of exercises, when the purpose is to move limbs freely), it is hard to maintain comfort during flexibility assessment, especially in sitting posture. Discomfort during assessment of FFD test could been caused by vertigo after sudden change from few minutes of physical effort in horizontal posture to vertical posture.

Investigation of graphic models of gained results have two merits. Firstly, it deepens validation rating of tests [13]. Secondly, it complements hypothesis formulated above.

Models of results that verify subjective rating of SABS and SASRT advantages are similar. Indicators of SABS are more accumulated in term of situation A and C, but they are spread identically in situation B. Meanwhile model of result for FFD test is denying those regularities showed by other tests. Accumulation of indicators referred to SABS and SASRT in situation B (with lowest score from 4.50 to 4.79) is logical representation of the truth about measured phenomena, which proves validity of these tests.

For first 30 minutes of exercises during training session, judokas were performing warm-up exercises, *ukemi* (falls for different sides) and *uchikomi* (exercises preparing for executing throws performed in pairs). Those exercises stimulated the body, that is why there was less discomfort feelings and advantages of tests were emphasized by high scores of other indicators. In these measuring circumstances, dispersion of indicators values from 4.17 (compatibility with own perception of flexibility) to 4.75 points (perception of security) during application of FFD test, undermines its validity. Even more dispersion of results took place during usage of this test in situation A (highest discomfort), while accumulation of mean values of indicators in situation C between 4.42 to 4.58 eluded from rational explanation. This confirms questionable usability of FFD test, especially for diagnosing in health-related training and physiotherapy.

In this experiment, judo exercises were used as a form of health-related training. But it does not mean, that characteristic of physical effort can be put analogically to professional judo training [18-20]. The way haw those exercises are used fully depends on competence of health-related training specialist [17,21] or physiotherapist. Analyzed results give important argumentation, which states that in any kind of training, assessment of workload (as one of criteria of extremity of physical activity [22-24]) should be examined multi-perceptively, including many detailed indicators. Only associating part of results based on self-perception questionnaire indicators applied in this study, highlights how important for training workload is to use specific exercise in proper time.

Important finding of this study is necessity of associating results of tests (in this case it is flexibility) with subjective sensations of indicators, which verify usability of test, with content and duration of exercises before assessment. Based on this

multidimensional analysis, we can conclude with high probability about quality of performed exercises. Results of reliable flexibility test is essential for this kind of multidimensional analysis and could give direct information about generating unnecessary high muscle tonicity during motor activity that requires effective usage of in a short period of time. This is the essence of judo fight – elasticity of boy and mind. Unnecessary tension of muscles and mind may be deadly.

CONCLUSIONS

1. Simultaneous application of SASRT and self-perception scale are simple tools for diagnosing flexibility in different states of body stimulation and direct assumptions about generating unwanted muscle tension during exercises (*randori)* before assessment.

2. Usage of SASRT and subjective sensations scale of test's usability in the same assessment provides simple tool for valid diagnosis of flexibility level, that put together with test results and indicators of physical effort workload, allow to conclude about quality of exercises performed before flexibility assessment.

COMPETING INTERESTS

Author has declared that no competing interest exists.

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