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# Time-motion performance in semi-professional Lithuanian women's judo athletes

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**A** Study Design
**B** Data Collection
**C** Statistical Analysis
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## Abstract

**Background and Study Aim:** Time-motion analysis can provide specific information for the judo physical and technical performance in each group and weight categories. The aim of this study was to verify the hypothesized that Lithuanian-female judo athletes of light-weight categories (under 48 kg and under 52 kg) perform faster time-motion actions during a match compared to heavier categories.

**Material and Methods:** Analyses of literature resources, competition match protocols and pedagogic surveillance methods were applied in this study. The statistic computation was performed using SPSS 18.0 for Windows. Data was collected from 58 high rank female adults fights at the Lithuanian Judo Championship 2016.

**Results:** It was identified that only the indicators of total time of technique ($p<0.025$) and groundwork (*ne waza*) combat time ($p<0.016$) with regard to women's judo matches significantly differ between the weight category under 52 kg and under 70 kg. Moreover, differences of *ne waza* time between the weight categories under 63 kg and under 70 kg were found to be statistically significant ($p<0.0311$). Significant difference of displacement without contact time ($p<0.035$) was observed only between the weight categories under 48 kg and under 52 kg. No significant time-motion data differences were observed among other weight categories ($p>0.05$). The hypothesis that indicators of light-weight matches time-motion data significantly varies from heavy weight categories was proved only partially.

**Conclusions:** Lithuanian women judo athletes of lighter weight feature with faster motions while competing in verical posture (standing position), without a grip and with a grip. The heavier athletes are slower and, except the tasks in ne waza, all motions are performed longer. In case of competition high level women judo athletes, their indicators of time-motion data are adequate to results of international elite athletes.

**Key words:** combat sport • exercise of athletes • martial art • performance • tactic • technique



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## INTRODUCTION

There are three main ways during the match when an athlete can score to win a judo match [1]: *nage-waza* – throwing techniques, which are subdivided into *te-waza* (arm techniques), *koshi-waza* (hip techniques), *ashi-waza* (leg techniques), *sutemi-waza* (sacrifice techniques) and *yoko-sutemi-waza* (side sacrifice techniques); *katame-waza* – grappling techniques, which are subdivided into *osae-waza* – immobilization techniques, *shime-waza* (submission of the opponent via strangulation) or *kansetsu-waza* (joint-lock techniques); penalties received by the opponent.

To produce recording of an event and then to analyze it on purpose, in order to provide feedback to athlete and coach to increase performance is not new [2-4]. In order to develop the most efficient and effective training program possible, knowledge of the match time structure is required [5-7]. In this regard, a number of studies conducted time-motion analyses of judo match [8, 9]. Time-motion analysis can provide specific information for the judo physical and technical performance in each group and weight categories [9, 10].

Judo is an intermittent sport. As such, it is important to characterize the actions involved in combat so that training may be structured in such a way as to simulate competitive demands [11]. A detailed description of the activity profile during intermittent sports has both technical-tactical and physiological applications. Concerning technical-tactical aspects, a training program could be improved by simulating the main occurrences during judo matches. From a physiological point of view, this information could help to establish a better understanding of the energy system contribution during a competition, which could be used to design more specific training programs to enhance performance during competitions [12].

In order to design fight tactics in judo it is highly important to find out time-motion and technical characteristics during matches in each group and weight categories [9]. These findings would allow the coach to apply right trainings for preparation period [13]. Continuous analysis of time-motion and technical performance during judo match is the way to improve sports results [14]. For this task the feedback is highly important, since it allows both to control, and to improve the process of training [15], and also to prevent injuries that might occur during the match [16].

Although optimal values of indicators of judo time-motion data are established, however, each athlete features with particularities that are highly determined based on the weight category [17]. Interestingly, studies of time-motion characteristics in female semi-professional judo, related to weight categories and technical level, have not been published.

Thus the research question emerged, whether the indicators of time-motion data for different weight category judo women differ? Leading to the objective of the study; to identify peculiarities of time-motion matches of different women's judo categories.

The aim of this study was to verify the hypothesized that Lithuanian-female judo athletes of light-weight categories (under 48 kg and under 52 kg) perform faster time-motion actions during a match compared to heavier categories.

## MATERIAL AND METHODS

### Participants

The study was carried out during the Lithuanian Judo Championship 2016. The sample comprised 87 matches (Table 1), by 69 girls and women from age 16 to 28. According to Lithuanian Judo Championship rules, younger athletes (16 years and below) could participate in the championship only if they are high level – brown belt (1 kyu) or black belt (1 dan or above). Each of these 87 performances were matches performed by two athletes. Each match was independent of each other as athletes never fought against the same rival during the championship.

**Table 1.** Investigated and analyzed judokas and observed matches data by weight categories.

| Weight categories (kg) | Subjects (n) | Age, years (yrs) | Experience (yrs) | Matches observed (n) |
|---|---|---|---|---|
| 48 | 9 | 17.7 | 8.3 | 12 |
| 52 | 10 | 18.5 | 7.6 | 13 |
| 57 | 12 | 20.3 | 10.8 | 14 |
| 63 | 16 | 21.4 | 9.6 | 22 |
| 70 | 10 | 22.9 | 11.4 | 12 |
| 78 | 6 | 18.3 | 7.8 | 7 |
| >78 | 6 | 21 | 10.3 | 7 |

**Nage waza** – throwing techniques [31].

**Katame waza** – grappling techniques [31].

**Tachi waza** – standing techniques.

**Ne waza** – ground techniques [31].

**Te waza** – hand techniques [31].

**Koshi waza** – hip techniques [31].

**Ashi waza** – foot / leg techniques [31].

**Sute mi waza** – sacrifice technique [31].

**Osae waza** – hold-down techniques [31].

**Shime waza** – choking techniques [31].

**Kansetsu waza** – joint locks technique [31].

**Dan** (**dan'i)** – a term used to denote one's technical level or grade [33].

**Performance** – *noun* the level at which a player or athlete is carrying out their activity, either in relation to others or in relation to personal goals or standards [32].

**Injury** – *noun* damage or a wound caused to a person's body [32].

**Technique–** *noun* a way of performing an action [32].

**Technique –** specific procedures to move one's body to perform the task that needs to be accomplished [34].

**Tactics** – decisions and actions of players in the contest to gain an advantage over the opposing players [34].

The sport experience average of the studied individuals was 9.4 ±1.52 years. Matches of all weight categories were analysed (under 48 kg, under 52 kg, under 57 kg, under 63 kg, under 70 kg, under 78 kg and over 78 kg). Eight matches were analysed in the categories under 48 and under 52 kg, the analysis of category under 57, under 63 and under 70 kg included ten matches, and six matches were analysed in category under 78 kg and category over 78 kg each. Informed consent was obtained from each participant prior to voluntary participation in the match performance assessment.

The study was approved by the Local Regional Research Committee in accordance with the guidelines of the Declaration of Helsinki.

### Procedures

Lithuanian championship matches were recorded using two video cameras PANASONIC/HDC-SD800 from the different competition place corners. The participants were informed on the objectives of the study. Later, indicators of time-motion data of all the observed matches were registered in judo time-motion protocols. Based on judo time-motion model developed by scientific researchers [9, 12, 18] , as with regard to the validity of indicators of the analysed female athletes time-motion data, the approved three qualified (2 and 6 dan) experts described attributes of the beginning and end motions [19, 20]. Experts registered motions while observing the match. In case of discrepancies, a motion was repeatedly analysed watching video records and experts repeatedly identified the duration of motions.

### Measurement

All the varying time data of each combat motions and movement were recorded following the preceding recommendations [9]. A variables list obtained from previous studies [9, 21] was used to formulate the list of time-motion indicators used in match analysis. Groups of variables were composed of: total combat time (TCT); standing combat time (SCT); pause time (PT); groundwork combat time (GCT); displacement without contact (DWC) and gripping time (GT). In addition, the frequency of appearance of each time-motion indicator was collected in each match and expressed per second of playing time: TCT was identified as combat time period between the referee command *hajime*, command to stop (*matte*) and referee command to finish fight (*sore-made*); SCT (*tachi-waza*) was identified by the period in which one or both fighters executed standing combat, trying to perform throwing techniques (*nage-waza*); DWC defined by the time between the referee command *hajime* (beginning of combat) and the execution of the grip (*kumi-kata*), when athletes do not have any contact between them; GT (*kumi-kata*) defined by the time between the accomplishment of the grip and the lack of contact on the opponent judogi; GCT (*ne-waza* time) was identified when one or both fighters executed groundwork techniques (*ne-waza*), according to the referee; PT was defined by the period between the referee command *matte* and command *hajime*; TT defined from beginning to make a throw until athlete or both of them finished technique or combination (evaluated or not).

All time-motion indicators was based on protocol used on the analysis of combat time frame according to Gorostiaga [22] and Calmet et al. [8].

The frequency of each time-motion indicator was collected per match and expressed by second of playing time, following preceding recommendations [9, 21]. Each combat phase is formed by specific technical–tactical actions, which could influence the success in the combat [23]. They are called performance indicators, and these variables were designed by other studies [8, 9, 18].

### Statistical analysis

The data were tested for normal distribution using the Kolmogorov–Smirnov test, and all data were found to be normally distributed. Descriptive data was presented as mean ± SD. One-way ANOVA (General Linear Model) was used to determine the effects of the weight category. Cohen's Kappa as a measure of the inter-rater reliability was used. The significance level was set at $p = 0.05$. All statistical analyses were performed using IBM SPSS Statistics 23 (IBM Corporation, Armonk, NY).

## RESULTS

Significant differences were identified between indicators of individual time-motion data of a few weight category female athletes that participated in the Lithuanian Judo Championship (Table 2).

Indicators of movement without grip time in weight categories under 48 kg and under 52 kg ($p<0.035$) differed significantly. Athletes of

**Table 2.** Total duration of time-motion of the Lithuanian Women Judo Championship matches (average ± standard deviation) in all weight categories, in seconds.

| Time-based characteristics of motions | Weight categories of judo athletes and number of matches | | | | | | |
|---|---|---|---|---|---|---|---|
| | 48 kg n = 9 | 52 kg n = 10 | 57 kg n = 12 | 63 kg n = 16 | 70 kg n = 10 | 78 kg n = 6 | >78kg n = 6 |
| TCT | 122.2 ±91 | 180.4 ±81 | 146.3 ±113 | 163.5 ±109 | 104.6 ±120 | 164 ±83.4 | 199 ±121 |
| SCT | 66.2 ±50.1 | 95.3 ±44.5 | 82.3 ±66.9 | 82.1 ±51.0 | 65.7 ±72.2 | 85.3 ±32.6 | 107.8 ±72 |
| DWC | 19.2 ±14.1[1] | 36.0 ±18.7[1] | 34.3 ±30.9 | 23.5 ±14.9 | 21.3 ±26.8 | 30.1 ±15.0 | 42.3 ±28 |
| GT | 43.9 ±36.4 | 53.4 ±36.5 | 43.5 ±35.7 | 54.9 ±38.5 | 43 ±48.6 | 51.7 ±21.2 | 62.0 ±47.3 |
| GCT | 24.5 ±18.7 | 38.9 ±19.3[2] | 33.3 ±15.7 | 37.8 ±25.6[3] | 16.2 ±19[3,2] | 35.7 ±19.0 | 28.8 ±15.9 |
| PT | 31.6 ±27.7 | 46.2 ±29.8 | 30.8 ±34.0 | 43.7 ±44.3 | 22.3 ±32.9 | 46.4 ±41.8 | 62.8 ±60.6 |
| TT | 3.1 ±1.9 | 5.8 ±3.6[2] | 4.5 ±2.5 | 3.8 ±1.8 | 2.5 ±2,5[2] | 3.4 ±2.1 | 3.5 ±1.3 |

Note: **TCT** total combat time; **SCT** standing combat time; **DWC** displacement without contact; **GT**gripping time; **GCT** groundwork combat time; **PT** pause time; **TT** technique time; [1] significant difference between weight categories under 48 kg and under 52 kg ($p<0.05$); [2]significant difference between weight categories under 52 kg and under 70 kg ($p<0.05$); [3]significant difference between weight categories under 63 kg and under 70 kg ($p<0.05$)

category under 52 kg almost moved without gripping for almost twice the length of time, if compared with athletes from weight category under 48 kg. The significant difference was identified between weight categories under 52 kg and under 70 kg while fighting without contact ($p<0.025$) and on groundwork ($p<0.016$). The indicators of both mentioned indicators lower in matches of weight category under 70 kg. Significant difference of groundwork combat time ($p<0.0311$) was observed between the weight categories under 63 kg and under 70 kg. Here the results of weight category under 70 kg of groundwork combat time were significantly lower compared to weight category under 63 kg. Other match motions did not significantly differ statistically.

## DISCUSSION

When comparing the values of indicators of time-motion data of the analysed athletes (n = 69) during the Lithuanian Judo Women Championship with research data obtained during the Braziliant Women Championship (n = 237) [23], significant differences were not observed.

Judo time-motion is described by a combat that can take up to four minutes (in women competitions) and more [1]. In order to announce a winner, if four minutes are not enough, the additional unlimited time is given (golden score), during which time one of the athletes will make a high-scoring technique or will be penalized. Four to five combats may be held within one day. This depends on a level of competition and the type of draw system applied. Such circumstances of judo combats also have influence to characteristics of time-motion data [24]. Furthermore, the style of the opponent's combat also has an influence on indicators of athletes' time-motion data [25], especially related to unpredictably applied techniques [8] and different types of attacks [18].

The duration of combat time may be influenced by athletic, technical, psychological, tactic readiness of judo athletes and especially the individual method to compete [26]. Since the percentage expression of the duration of a match of the Lithuanian judo athletes is equivalent to elite representative Brazilian judo athletes, we could make a presumption that components of all athletes' readiness shall be equal [27]. It was identified that time-motion indicators, independently from level of competitions and skills of athletes, are equal, if the competition is held among the same skill level athletes [23]. However, how indicators of time-motion data should differ if comparing highly-skilled Lithuanian judo athletes (women) with elite athletes should be analysed. Furthermore, it should be noted that the duration of matches of highly-skilled Lithuanian judo athletes was longer when competing between heavier athletes and as a result, shorter – among lighter athletes. It is presumed that judo athletes of increased body mass, are not so active during the combat [17].

Further studies should define factors, influencing not only duration of a match in general [9], but

also to identify peculiarities, common for individual weight categories.

Considering that time of movement without a grip and with grip of the Lithuanian Judo Championship lighter-weight athletes is shorter when compared to athletes of the increased weight categories (except weight category under 70 kg, where one athlete surpassed the opponents having better skills and her match results influenced average values of time-motion data indicators of weight category under 70 kg), it is presumed that lighter athletes move more actively and quickly [15].

When the indicators of the athletes that took part in the Lithuanian Judo Championship are compared with the averages of all Brazilian age groups, it is observed that results of match motions of the Lithuanian athletes are equivalent, except during combat in a standing position, since these indicators correspond to indicators of the Brazilian youth age athletes [9]. The presumption is made that results are influenced by the fact that a high number of athletes (72 %) of the Lithuanian championship, who according to the birth date also participate in youth and juvenile age group competitions, have relevant skill-level and are allowed to participate in adults' competitions.

The objective of this study was to identify characteristics of time-motion data of highly-skilled athletes from different weight categories who participated in the Lithuanian Judo Championship 2016. Considering that 48 % of Lithuanian Women Judo Championship matches were completed prior to the full 4 minutes of time (weight category under 48 kg = 36%, weight category under 52 kg = 41%, weight category under 57 kg = 32%, weight category under 63 kg = 51%, weight category under 70 kg = 76%, weight category under 78 kg = 61% and weight category over 78 kg = 52% respectively), this defines sufficiently different level of skills between athletes. The indicators of elite athletes (men) who completed matches prior time, vary from 44% till 58% [28, 9]. Athletes (women) representing the elite in the Brazilian championship, 34% finishes the combat prior the time [23].

Indicators of weight category under 70 kg were influenced by exceptional skills of one athlete, because she had completed all combats prior to the provided time and significantly improved indicators of time-motion data of this weight category. It was identified [29] that the direct competition between two opponents, as the judo combat is, has a significant influence to indicators of dynamically varying model and the final result of match may be influenced by temporal time-motion models applied by judo athletes in individual competitions. However, based on analysis of time-motion data of a single championship, unequal technical readiness of high-skill level of the Lithuanian women judo athletes in general can not be stated not only because of small scope of this study, but also contra-verse results of elite men judo athletes [9, 28]. Starting from 1st January 2014, the rules have been altered [1] and the women match was shortened from five minutes to four. However, despite the alterative rules of competition, when in 2012 the rules were tightened, promoting the activity of a match, new alterations had influence to a match structure [10, 30]. Having compared previous results of the Castarleno and Plano [28] study with a more recent study [10], the similar combat motion indicators between men and women were identified, although the time period between the studies exceeded 10 years and with regard to alteration of rules, the match duration was changed several times.

The hypothesis (that indicators of athletes of light-weight category matches time-motion data will significantly vary from indicators of athletes of heavy weight categories) was proved only partially, because only significant differences between weight categories under 52 kg and under 70 kg of two matches motion time (groundwork combat match and technique performance) were established.

It is recommended to perform longitudinal time-motion studies and, moreover, it would be purposeful to compare indicators time-motion data of younger age judo athletes. This could assist in surveying motion-time alteration of a match and coaches could alter programs for athlete preparation.

## CONCLUSIONS

The current study was the first to describe time-motion patterns in semi-professional female judo matches and to conduct a comparison among different weight categories. In the case of competition of high-skill level athletes of the Lithuanian

women's judo, the indicators of time-motion data are equivalent to indicators of elite time-motion data.

The results indicated that Lithuanian female judo athletes of lighter weight feature with faster motions while competing in a standing position, without a grip and with a grip, and heavier athletes are slower and, except during groundwork, all motions are performed longer. These differences in movement patterns among weight categories need to be reflected in training practices.

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