Model characteristics of competitive activity of female MMA mixed martial arts fighters of different weight classes

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Abstract

Purpose: to determine model characteristics of the competitive activity of female MMA mixed martial arts athletes of different weight classes.

Material & Method: the study involved 150 top female mixed martial arts MMA fighters. Participants were divided into 3 groups according to the weight class of 50 athletes each: Strawweight (48 kg to 52 kg), Flyweight (52 kg to 56 kg), and Bantamweight (56 kg to 61 kg). The following methods were used: analysis of scientific and methodological information and Internet sources; generalization of best practices; analysis of protocols and videos of competitive activities; methods of mathematical statistics.

Results: female athletes of each weight class have their characteristics in terms of competitive activity indicators. Thus, the finish of the fight with a striking differential, attempts, and accuracy of takedowns is significantly better ($p<0.05$-0.01) in women`s strawweight fighters. Strawweight female fighters perform a large number of sig strikes landed, which have high accuracy, due to which they win the fight, and this is explained by a large arsenal of technical and tactical actions. Women's flyweight fighters need more time to finish the fight early. They also have the least number of sig strikes landed during the fight, which are performed with little accuracy, and this is due to the rational distribution of strength in a fight. Women's bantamweight fighters conduct a large number of knockdowns landed and submissions during the entire fight, this can be explained by the high level of development of special endurance. It was found that the representatives of all weight classes perform mostly distance strikes landed and their sig head strikes landed are the best ones.

Conclusions: applying methods of pedagogical observation and mathematical statistics allowed us to determine the structure and model characteristics of modern competitive activities of elite female mixed martial arts MMA athletes for each weight class. The model characteristics obtained during the study can be used to plan the training process of qualified female athletes and to solve the issues of managing their preparation for competitions.

Анотація

Юрій Тропін, В'ячеслав Романенко, Войцех Й. Цинарський, Наталія Бойченко, Юлія Коваленко. Модельні характеристики змагальної діяльності спортсменок змішаних єдиноборств ММА різних вагових категорій. Мета: визначити модельні характеристики змагальної діяльності спортсменок змішаних єдиноборств ММА різних вагових категорій. **Матеріал і методи:** у дослідженні взяли участь 150 топових спортсменок змішаних єдиноборств ММА. Учасниці були розділені на 3 групи за ваговими категоріями по 50 атлеток в кожній: мінімальна (від 48 кг до 52 кг), найлегша (від 52 кг до 56 кг), легка (від 56 кг до 61 кг). Використовувалися наступні методи: аналіз науково-методичної інформації та джерел Інтернету; узагальнення передового практичного досвіду; аналіз протоколів і відеозаписів змагальної діяльності; методи математичної статистики. **Результати:** у спортсменок кожної вагової категорії спостерігаються свої особливості в показниках змагальної діяльності. Так закінчення бою за позитивної різниці в ударах, спроби й успішність виконання тейкдаунів достовірно краще ($p<0,05$-0,01) у спортсменок мінімальної ваги. Спортсменки мінімальної ваги в бою виконують велику кількість акцентованих ударів, які мають високу

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точність, за рахунок чого і досягають перемоги в бою, це пояснюється великим арсеналом техніко-тактичних дій. Більш часу для дострокового завершення бою потребує спортсменкам найлегшої категорії. Також у них під час бою найменша кількість акцентованих ударів та невелика їх точність, це пояснюється раціональним розподілом сил в бою. Спортсменки легкої ваги виконують велику кількість нокаутирующих ударів і проводять сабмішен під час всього бою, це пояснюється високим рівнем розвитку спеціальної витривалості. Встановлено, що представниці всіх вагових категорій більш всього проводять акцентованих ударів на дистанції та у них найкраще удари проходять в голову. **Висновки:** застосування методів педагогічного спостереження та математичної статистики дозволили визначити структуру та модельні характеристики сучасної змагальної діяльності елітних спортсменок змішаних єдиноборств ММА для кожної вагової категорії. Модельні характеристики, які були отримані в ході дослідження можна використовувати для планування тренувального процесу кваліфікованих спортсменок та для вирішені питань керування їх підготовкою до змагань.

Introduction

Mixed Martial Arts is a sport that includes a variety of ways to defend and attack in the fights. The basis of mixed martial arts is classical wrestling (Greco-Roman and Freestyle Wrestling, Judo, Jujutsu, etc.) and classical striking technique (Boxing and Kickboxing) (Sohor & Pityn, 2017; Tropin et al., 2021).

The popularity of MMA in the world and the growing competition among fighters require careful study of the competitive activities of leading athletes to find new ways to improve the effectiveness of the training process and competitive activity (Katykhin et al., 2021; Latyshev et al., 2021).

The competitive activity of athletes in contact martial arts has a high motor activity, which requires a fighter to show the ability to perform various technical and tactical actions with a high degree of accuracy and adequacy of the strategy of the entire fight.

The level of technical and tactical actions of a fighter mainly determines his success in a competitive duel. Scientific and methodological support for the training of qualified martial arts requires, above all, the choice of the most effective actions and their further improvement. This is since the composition and structure of effective technical and tactical actions are changing rapidly in sports practice. To train qualified athletes it is important to timely inform about the promising areas of development of a particular type of martial arts (Romanenko et al., 2020; Starikov et al., 2021).

In mixed martial arts MMA, there is a very large number of techniques from different types of martial arts. It plays a key role in the way how an athlete can combine different disciplines and change from striking technique to wrestling (Pityn et al., 2013; James et al., 2017).

In terms of preparing for competitions, some mixed martial arts fighters try to conduct most training sessions in basic classical types (boxing, kickboxing, or wrestling), mistakenly try to adjust this technique to the rules of mixed martial arts, which violates the principle of competition, its structure and also the content of athletes' preparation program.

Analysis of competitive activity in mixed martial arts MMA is essential for predicting the success of skilled athletes, which is extremely important and relevant at the present stage of their development.

Purpose of the study is to determine model characteristics of the competitive activity of female MMA mixed martial arts athletes of different weight classes.

Material and Methods of the research

Participants: The study involved 150 top female athletes of mixed martial arts MMA, who have their records in terms of competitive activity. These figures reflect the statistics of all fighters in the UFC 28 tournament (since 2000) up to date (UFC 28 was the first tournament to apply the Unified Rules of MMA). Participants were divided into 3 groups according to the weight class of 50 athletes each: Strawweight (48 kg to 52 kg), Flyweight (52 kg to 56 kg), and Bantamweight (56 kg to 61 kg). The initial data on the performances of the strongest female athletes in mixed martial arts MMA are taken from the UFC sites (http://statleaders.ufc.com/ru/fight?weight_class=WSW; https://fightnews.info/rejtingi-mma).

Methods. The following methods were used in the study: analysis of scientific and methodological information and Internet sources; generalization of best practices; analysis of protocols and videos of competitive activities of female fighters; methods of mathematical statistics.

Procedure. 150 title fights were analyzed, including 50 fights in the strawweight, flyweight, and bantamweight weight classes. To analyze the competitive activity the following indicators were investigated: time of the fight (s); the total number of performed and missed significant strikes in the fight (number); the number of takedowns and submissions attempts in the fight (number); sig strike accuracy (was determined by dividing the number of effective strikes by the number of sig strikes landed and multiplied by 100 %); the accuracy of takedowns (was determined by dividing the number of successful takedowns by the number of takedowns attempted and multiplied by 100 %).

Takedown is taking an opponent to the ground. At the same time, each of the fighters tries to take a dominant position to further strike or successfully conduct choking techniques.

Submission occurs when one of the opponents admits his defeat. A feature of the submission – is a victory achieved through painful, or suffocating holds, as a result of which one of the fighters gives up, visibly tapping the floor or the opponent with the hand or in some cases with the foot, or verbally.

Statistical analysis of the obtained data was performed using the licensed program MS Excel (2010). Indicators of descriptive statistics were determined: arithmetic mean, standard deviation, and mean absolute error (Antomonov, 2006). The significance of mean differences was assessed with Student's t-test; withdrawal was considered reliable at ($p<0.05$).

Results of the research

Table 1 presents the model characteristics of the competitive activity of female mixed martial arts MMA athletes of different weight classes.

The analysis of the data obtained showed that women's bantamweight fighters spend less time finishing the fight early and have the fastest knockout (technical knockout), and

Table 1

Model characteristics of the competitive activity of female mixed martial arts MMA athletes of different weight classes (n=150 fights)

№	Indicators	Weight class Strawweight (n=50 fights) $\bar{X}\pm m$	Flyweight (n=50 fights) $\bar{X}\pm m$	Bantamweight (n=50 fights) $\bar{X}\pm m$
1	Fastest Finish, s	69,7±8,91 [1]	116,4±13,05	51,3±12,04 [3]
2	Fastest KO/TKO (knockdowns/technical knockdowns), s	122,4±28,61 [1]	223,9±25,62	69,9±15,78 [3]
3	Fastest Submission, s	118,0±10,93	129,8±11,07	128,7±29,83
4	Latest Finish (time left until the end of the fight), s	117,2±14,66	132,2±27,32	69,5±13,81 [2]
5	Latest KO/TKO (time left until the end of the fight), s	113,0±23,22	164,6±22,87	112,3±20,50
6	Latest Submission (time left until the end of the fight), s	134,3±14,6	99,8±27,14	80,6±6,83 [2]
7	Striking Differential, number	107,6±6,03	76,8±4,96 [1]	79,9±7,52 [2]
8	Largest Comeback Finish, number	11,5±4,19	7,0±1,97	15,9±2,33 [3]
9	Sig Strikes Landed, number	176,6±8,83	151,4±10,76	157,9±9,56
10	Sig Strikes Attempted, number	365,2±10,86 [2]	357,4±16,74	327,0±13,16
11	Sig Strike Accuracy, %	73,7±1,61	70,3±1,70	71,4±1,13
12	Distance Strikes Landed, number	154,6±8,36	138,5±11,40	139,7±8,40
13	Sig Clinch Strikes Landed, number	50,8±2,77 [1]	27,9±1,82	44,5±5,09 [3]
14	Sig Grounded Strikes Landed, number	49,9±4,76	42,0±5,67	41,3±2,56
15	Sig Head Strikes Landed, number	100,9±2,25	115,1±10,61	110,7±8,63
16	Sig Body Strikes Landed, number	48,6±1,57	43,0±2,48	42,1±3,14
17	Leg Kicks Landed, number	55,9±5,14 [2]	43,7±3,62	36,6±2,84
18	Takedowns Landed, number	6,6±0,58	5,8±0,33	5,5±0,31
19	Takedowns Attempted, number	14,7±0,60	12,0±0,60 [1]	12,0±0,89 [2]
20	Takedowns Accuracy, %	54,5±5,98	26,54±5,09 [1]	29,76±7,24 [2]
21	Submission Attempts, number	3,9±0,35	3,2±0,36	3,2±0,2

***Note*:** 1 – the differences between groups 1 and 2 are accurate ($p<0.05$); 2 – the differences between groups 1 and 3 are accurate ($p<0.05$); 3 – the differences between groups 2 and 3 are accurate ($p<0.05$).

women's strawweight fighters conduct the fastest submission. Women's flyweight athletes need more time to finish the fight early, and they also need more time at the beginning of the fight to perform a knockout (technical knockout) and submission.

Time indicators of competitive activity «Latest Finish», «Latest KO/TKO», «Latest Submission» are higher in women's bantamweight athletes, and indicators «Latest Finish», and «Latest KO/TKO» are the lowest in women's flyweight fighters and «Latest Submission» in women's strawweight.

Women's strawweight fighters finish the fight early with the largest striking differential, and the largest comeback finish is observed in women's bantamweight fighters. These indicators are the lowest for women's flyweight athletes.

Women's strawweight fighters perform a large number of significant strikes accuracy in the fight. Women's flyweight athletes have the lowest number of significant strikes landed that reach the goal and low accuracy strikes.

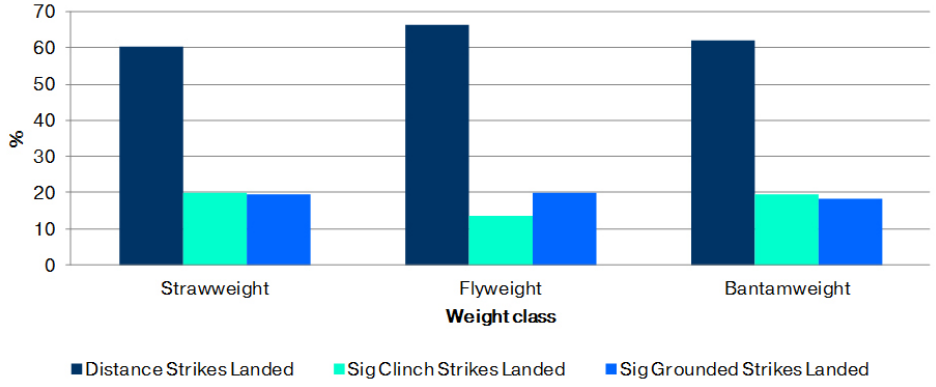

Figure 1. Ratio of the number of significant strikes in different positions at fighters of different weight classes, %

Figure 2. Ratio of the number of significant strikes to different targets at fighters of different weight classes, %

Submission attempts, takedowns attempted and takedowns accuracy are better conducted by women's strawweight fighters. These indicators do not differ significantly in women's flyweight and bantamweight athletes.

Fighters of all weight classes perform mostly distance strikes landed (Fig. 1) and sig head strikes (Fig. 2), this is due to the high possibility of knocking out the opponent.

Discussion

Many scientists have analyzed the competitive activity in various types of martial arts, so Aleksyeyev et al. (2021) analyzed the competitive activities of veteran judokas and established the motivation and psycho-emotional state of the athletes.

Khatsayuk et al. (2020) conducted a study of the technical arsenal of highly qualified MMA mixed martial arts fighters using the Katsumoto Martial Arts Express Computer Analysis System and divided all athletes into two groups of wrestlers and strikers.

Basing on competitive activity Boyko et al. (2014) established the main technical and tactical actions in the rack, which are carried out by elite freestyle wrestlers.

Ouergui et al. (2014) analyzed the temporal structure of high-level kickboxing fights and provided practical guidance on how to structure training sessions to mimic competitive physical activity.

Tunnemann (2017) examined the final fights in three styles of wrestling (Greco-Roman, Freestyle, and Women's) at the 2012 and 2016 Olympic Games and recommended the concepts for improving technical and tactical training to develop more attractive methods for the spectacle of wrestling.

According to James et al. (2017), the indicators of competitive activity of mixed martial arts MMA fighters were processed using statistical methods and found that wrestling activity and accuracy of technique were of particular importance to achieve victory in mixed martial arts competitions of the elite level.

Models were also made with the help of competitive activity analysis, so Boychenko (2017) developed models of technical and tactical training of karate specialists in the «power" and "tempo" manner of fighting and offered training tasks for them.

Katykhin et al. (2021) determined the profiles of the strongest mixed martial arts MMA fighters with TOP-10 regardless of weight and found that the strongest fighters had individual equipment and made a tactical plan of the fight considering the future opponent.

Martsiv (2015) developed model characteristics of indicators of boxers' competitive activity for the specialized basic training phase and recommended approaches to improve various aspects of athletes' training.

Slimani et al. (2017) identified models of elite kickboxers based on gender, weight class, rounds, and match outcome and found that training programs needed to be adapted to the specific requirements of weight class and gender of kickboxers to improve technical and tactical skills that increase the athlete's chances of winning.

Tropin and Chuev (2017) developed model characteristics of technical and tactical training of elite Greco-Roman style wrestlers based on which evaluation criteria were developed.

Miarka et al. (2018) highlighted the features and time parameters of each round of mixed martial arts MMA fighters. Basing on them it was found that the minimum time spent on low-intensity bouts in the rack, regardless of the round, and the strength of action on the ground in the first and second rounds, increase the probability of success in professional MMA fights. These factors are important for the development of a program to improve technical and tactical training.

Summing up, we can say that the process of training qualified female mixed martial arts MMA fighters should be based on the laws of competition and model characteristics of the best fighters in the world. If these conditions are met, there is a high probability of forming an effective style of confrontation at the stage of preparation for higher achievements.

Prospects for further research will be aimed at developing sets of tasks for women's fighters, considering the features of the model characteristics of competitive activities of mixed martial arts MMA athletes of different weight class and their implementation in the training process.

Conclusions

Applying methods of pedagogical observation and mathematical statistics allowed us to determine the structure and model characteristics of modern competitive activities of elite mixed martial arts MMA fighters for each weight class. The model characteristics obtained during the study can be used to plan the training process of qualified athletes and to address issues of managing their preparation for the competitions.

Our results showed that athletes of each weight class have their characteristics in terms of competitive activity. Thus, the finish of the fight with a striking differential, attempts, and

accuracy of takedowns is significantly better ($p<0.05$-0.01) in women`s strawweight fighters than in women's flyweight and bantamweight. Strawweight female fighters perform a large number of sig strikes landed, which have high accuracy, due to which they win in the fight, and this is explained by a large arsenal of technical and tactical actions.

Women's flyweight fighters need more time to finish the fight early. They also have the least number of sig strikes landed during the fight, which are performed with little accuracy, and this is due to the rational distribution of strength in a fight.

Women's bantamweight fighters conduct a large number of knockdowns landed and submissions during the entire fight, this can be explained by the high level of development of special endurance.

It was found that the representatives of all weight classes perform mostly distance strikes landed and their sig head strikes landed are the best ones, this is due to the high possibility of knocking out the opponent.

Author Contributions
Yuriy Tropin: data collection, input, data analysis, manuscript preparation, statistics; Vyacheslav Romanenko: design, interpretation of data; Wojciech J. Cynarski: interpretation of data, analysis of literature search; Natalia Boychenko: design, research planning; Julia Kovalenko: research planning, translation.

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Conflicts of Interest
The authors declare no conflict of interest.

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