

Effect of short-term functional training intervention on athletic performance in elite male combat sambo athletes

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Abstract:

Excellent physical fitness is essential for improving the athletes' sport performance. Scientists reported that there is no full information on the impacts of functional training intervention on physical fitness in elite combat athletes. This investigation studied the effects of 4-weeks functional training loads (based on CrossFit® training) on athletic performance in elite combat sambo male athletes. *Research materials and methods.* Forty-four males – elite combat sambo athletes (mean age – 21.06±3.42 years) participated in this investigation. Twenty-two athletes (Experimental group – EG) practiced in 4-weeks functional training intervention during the pre-competition period. Other athletes (Control group – CG), don't applied functional intervention in the training routine. To determine athletic performance, all athletes were evaluated with regards to their performance during the three combat sambo tournaments within 4-weeks in post-intervention. The athletes' individual athletic performance (rank position – RP) was evaluated in accordance with guidelines of the German potential analysis system (PotAS). The athletes' technical effectiveness (TE) was conducted based on digital video recordings of competition combats. *Research results.* No significant differences were reported between EG and CG in RP and TE mean values during the first 2-weeks in competition cycle. There were significant ($p \leq 0.05$) differences in RP and TE mean values between EG and CG during the last 2-weeks in competition cycle. EG demonstrated a significant ($p \leq 0.05$) higher RP and TE mean value, comparison in CG. *Conclusions.* A 4-weeks functional training intervention based on CrossFit® specific training can be implemented in pre-competition period of elite combat sambo male athletes when preparing for national competitions to enhance athletic performance.

Key words: combat sports, CrossFit®, functional training (FT), potential analysis system (PotAS).

Introduction

Currently, sport wrestling and other combat sports are characterized by high competition and it requires a high level of physical fitness and technical & tactical training of athletes (Kolodeznikova et al., 2021). Investigators reported that strength performance stands out as the most important factor among the performance indicators of combat athletes, while the anaerobic energy system is predominantly used (Gürsoy, & Canli, 2021).

Various strength training programs provide to positive changes in body composition and power characteristics in individuals (Prvulovic et al., 2021). However, strength & conditioning professionals don't have a single opinion about the best method of resistance training to developing elite athletes' physical fitness (Li et al., 2019). Currently, strength training protocols for majority of sports including different combat sports utilize the normal available weight machines and free weight apart from the most widely used bodyweight functional & strength training (Osipov et al., 2021). Scientists and sport & conditioning professionals discovered positive effects of various functional training methods: high-intensity interval training (HIIT) (Ojeda-Aravena et al., 2021), CrossFit® training (Smirnova et al., 2021;), plyometric training (Ioannides et al., 2020) and circuit training (Susanto et al., 2021).

Elite athletes must maintain their excellent physical shape and technical skills for competitions (Osipov Kudryavtsev et al., 2020). Thus, meticulous physical and technical & tactical preparations in elite athletes, who practice sambo & combat sambo, are critical for competitions (Drid et al., 2021; Koshcheyev, & Dolbysheva, 2021). Russian investigators reported that most part of Russian elite combat sambo athletes demonstrate an

insufficient level of special physical fitness in competition matches (*Bolotin et al., 2021*). This is bad news, because a high level of functional fitness of combat athletes is a prerequisite for sports success (*Pryimakov et al., 2020*).

The rulesets vary greatly between different combat sports, with techniques such as punches and kicks being utilised in striking sports, chokes and joint locks in grappling sports, and a mixture of both kinds of techniques in mixed-style sports (*Alzhanov et al., 2021*). Competitive bouts can be concluded in many ways depending on the ruleset. Despite high level of popularity, there are still significant gaps in the scientific literature in profiling combat sports athletes, e.g. identifying physical characteristics such as strength and power relative to competition success of elite combat sports athletes (*Barley & Harms, 2021; Vorozheykin et al., 2020*). Combat sambo has many similarities with MMA in the requirements for the training of an athlete: strong level of striking and throwing techniques, good level of submission, and strong level of anaerobic and aerobic fitness, good power & strength characteristics. Despite the growing popularity of MMA in the world, there is still no uniform training system which could serve coaches and sports professionals as an indicator when planning and preparing specific training loads (*Tota et al., 2019*). The complexity of the combat sambo training system, considering physical, technical, tactical and capacity-related issues, is very challenging for the sport professionals and coaches. Previous scientific reports suggested that there may be a large variability in strength & conditioning training programs among combat & MMA athletes, while the large volume and high demands of training and competing may lead to fatigue, overtraining or overreaching (*Selitrenikova et al., 2022; Kostikiadis et al., 2018*). Also, investigators reported that current MMA training practices do not follow a current understanding of optimal athlete competition preparation (*Kirk et al., 2021*).

Scientific review suggested that sport & conditioning professionals proposed various strength, functional and complex training programs to improve speed & power characteristics and athletic performance of elite combat & MMA athletes. However, there is still no uniform training system which could serve as an indicator when planning and preparing specific training loads for elite combat sambo athletes. Therefore, this investigation studied the effects of 4-weeks of functional training loads (based on CrossFit® training) on athletic performance in elite male combat sambo athletes. It was hypothesized that this training intervention, despite its low volume and perceived effort, would confer greater improvements in athletic performance parameters that are important for elite combat sambo athletes.

Material & methods

Forty-four males – elite combat sambo athletes (mean age – 21.06±3.42-years-old). They were invited to participate in this investigation during the annual transition in competition period (October 2021) and randomly assigned into experimental group (EG – n=22; mean age – 20.85±3.16-years-old; mean height – 177.29±7.51 cm; mean body mass – 75.09±12.93 kg) and control group (CG – n=22; mean age – 21.26±3.44-years-old; mean height – 179.42±7.15 cm; mean body mass – 77.50±16.11 kg). To participate in this investigation, all participants had to meet the following inclusion criteria: A) five years or more of sambo & combat sambo experience; B) no history of disease and injuries or fractures during at least the last six months; C) consistently training at least six times per week for at least 17-18 hours per week; D) membership in the National Sambo Federation; E) taken part in official regional and national & international sambo & combat sambo competition tournaments during the current year; F) who competed in the higher 64-kg (lightweight) and the under 98-kg (heavyweight) categories. All participants were previously informed of the investigation purposes, associated benefits, experimental procedures, and potential by informed consent or informed assent before the assessments and training sessions. All ethical principles were observed. This scientific research was conducted in compliance with the ethical standards for sports science studies proposed by *Harriss, & Atkinson, (2015)* for publication studies involving human participants. This investigation was implemented after approval by the university ethics committee Siberian Federal University (Institute of Physical Culture, Sport and Tourism, Protocol no. 36/2022) following the Helsinki declaration for scientific work with humans.

The overall duration of this study conducted about 12-weeks (October, 2022 – December, 2022). The 1-th stage of this scientific research included functional intervention during the 4-weeks for EG. In parallel, the CG continued with their usual training routine. The 2-th stage of this investigation (measurement of athletic performance of all participants) was conducted during the three (two regional and one national) combat sambo tournaments (November, 2022). The overall data analysis was conducted during the 3-th stage of this investigation (December, 2022).

All participants were trained of 17-18 hours per week (each training session had a duration of 90-120 min). EG and CG had 2 training sessions a day (morning training and evening training) from Monday to Friday. All combat athletes had one training session in Wednesday and Saturday. Each training session included: adequate warm-up (20 min); main workout (80-90 min); cool-down exercises (10-20 min). Athletes performed stand-up fight (striking) trainings (SUF), ground fight (grappling) and throwing trainings (GTT), strength trainings (ST) and sparring sessions (SS) in pre-competition period.

The functional training (FT) program for EG had a duration of 10 workout sessions (4-weeks) of 60 min each session and was applied on three days (Monday, Thursday and Saturday) in the first and second weeks and two days (Monday and Thursday) in the third and fourth weeks in pre-competition period. Each FT began with adequate warm-up and stretching. Each training session included strength exercises: Push Press, Thrusters, Squats & Front Squats, Pull-ups and Chin-ups, and specific conditioning exercises: Battle Rope, one & two hands kettlebell swings (kettlebell weight – 16-24 kg), Rowing Barre, Box Jump, Burpees and Sprints (10 m) in different combinations with focus on building the speed and volume loads (max weight – 25-50% of maximum level for their single rep). EG performed these exercises (one functional set) uninterruptedly within 5 min in different variations. The recovery period between functional sets was 5 min. EG concluded the FT sessions with a cool-down consisting of static stretching exercises. The total duration of each workout session was one and a half hours. The total FT program for EG in pre-competition period (October, 2022) outlined in Table 1.

Table 1. The total FT protocol for EG in pre-competition period

1-FT set – 5 min
Sprints (10 m) – 30 sec, Pull-ups – 30 sec, Chin-ups – 30 sec, Squats & Front Squats – 90 sec, Battle Rope – 90 sec, Sprints (10 m) – 30 sec. RP – 5 min.
2-FT set – 5 min
Sprints (10 m) – 30 sec, Burpees – 60 sec, Push Press – 60 sec, Box Jump – 60 sec, Battle Rope – 60 sec, Sprints (10 m) – 30 sec. RP – 5 min.
3-FT set – 5 min
Sprints (10 m) – 30 sec, Pull-ups – 30 sec, Thrusters – 90 sec, Box Jump – 30 sec, Chin-ups – 30 sec, Battle Rope – 60 sec, Sprints (10 m) – 30 sec. RP – 5 min.
4-FT set – 5 min
Sprints (10 m) – 30 sec, Chin-ups – 30 sec, Box Jump – 30 sec, One & two hands kettlebell swings – 120 sec, Squats & Front Squats – 60 sec, Burpees – 30 sec. RP – 5 min.
5-FT set – 5 min
Sprints (10 m) – 30 sec, Push Press – 60 sec, Box Jump – 30 sec, Pull-ups – 30 sec, Burpees – 30 sec, Thrusters – 60 sec, Battle Rope – 60 sec. RP – 5 min.
6-FT set – 5 min
Sprints (10 m) – 30 sec, Squats & Front Squats – 90 sec, One & two hands kettlebell swings – 120 sec, Chin-ups – 30 sec, Box Jump – 30 sec. RP – 5 min.

Note: RP – Recovery period.

In the intermediate days (Tuesday, Wednesday and Friday in the first and second weeks; Tuesday, Wednesday, Friday and Saturday in the third and fourth weeks of the intervention), EG and CG followed the same training program, focused on combat technique (movements, strikes, throws) and grappling. All participants were rested for one day per week (Sunday). The total training program for both groups in pre-competition period (October, 2022) outlined in Table 2.

Table 2. The total training protocol for all participants in pre-competition period

Day (training time)	Training program	
Monday (11:00 – 13:00)	Overall training: WU – 20 min; SUF – 80 min; CD – 20 min	
Monday (17:30 – 19:00)	WU – 20 min; FT – 60 min; CD – 10 min for EG	WU – 20 min; GTT – 60 min; CD – 10 min for CG
Tuesday (11:00 – 13:00)	Overall training: WU – 20 min; GTT – 90 min; CD – 10 min	
Tuesday (18:30 – 20:00)	Overall training: WU – 20 min; SS – 60 min; CD – 10 min	
Wednesday (11:00 – 13:00)	Recovery	
Wednesday (17:00 – 19:00)	WU – 20 min; GTT – 80 min; CD – 20 min for EG	WU – 20 min; ST – 80 min; CD – 20 min for CG
Thursday (11:00 – 13:00)	Overall training: WU – 20 min; SUF – 80 min; CD – 20 min	
Thursday (17:30 – 19:00)	WU – 20 min; FT – 60 min; CD – 10 min for EG	WU – 20 min; GTT – 60 min; CD – 10 min for CG
Friday (11:00 – 13:00)	Overall training: WU – 20 min; SUF – 40 min; GTT – 40 min; CD – 20 min	
Friday (18:30 – 20:00)	WU – 20 min; SS – 60 min; CD – 10 min	
Saturday (11:30 – 13:00)	WU – 20 min; FT – 60 min; CD – 10 min for EG	WU – 20 min; ST – 60 min; CD – 10 min for CG
Sunday	Recovery	

Note: WU – warm-up; CD – cool-down; SUF – stand-up fight (striking technique); GTT – grappling and throwing training (ground fight & throwing technique); SS – sparring session; ST – strength training for CG; FT – functional training for EG.

After pre-competition period, EG and CG participated in a short competition cycle (two regional level tournament and one national level tournament with an interval of 9-12 days between tournaments). All combat athletes performed WU-SUF-CD or WU-GTT-CD (one hour for each training session) two times per day in this period, except for competition days. Also, all participants applied in rapid weight loss (RWL) before the competition. RWL is an approach of weight reduction is defined as a 5% weight loss achieved over 5-7 days.

To determine athletic performance, each combat athlete was evaluated with regards to their performance during the three (the two regional and one national) combat sambo tournaments which were scheduled within 4-weeks in post-intervention (November, 2022). The athletes' individual rank position during the tournaments was evaluated in accordance with guidelines of the German potential analysis system (PotAS) for elite sports (Büsch *et al.*, 2018). Scientists and sport professionals applied successfully this analysis system to determine and analyze the athletic performance in combat sports (Prieske *et al.*, 2020). The individual rank position (RP) for each subject during the combat sambo competition was evaluated using a graded specific score scale for this investigation: first place (gold medal) – 25 scores; second place (silver medal) – 20 scores; third place (bronze medal) – 15 scores; fifth-sixth place – 10 scores; seventh-eighth place – 5 scores; ninth-twelfth place – 3 scores; other place (attendance) – 1 score.

The analysis of the sports combat was performed based on digital video recordings of the examined athletes. The all-competition combat duels were recorded by means of a video camera (HDR-CX405; Sony, Tokyo, Japan). The overall data analysis was performed with IBM SPSS Statistics for Windows 20.0 (Armonk, NY: IBM Corp.). All data are presented as means and standard deviations (Mean ± SD). The distribution of each variable was examined using the Kolmogorov-Smirnov normality test. Homogeneity of variance was verified with the Levene's test. All variables are presented normal distribution. Independent t-tests to compare measured variables between groups were conducted. Also, Cohen's d effect size (ES) was calculated and classified as trivial – < 0.25; small – 0.25-0.50; moderate – 0.50-1.0; large – >1.0. The level of significance was set at $p \leq 0.05$.

Results

The overall information about combat athletes' athletic performance results (RP and TE mean values) in studied short competition cycle outlined in Table 3.

Table 3. The overall findings in combat sambo athletes' athletic performance in competition cycle

Tournaments	EG (n = 22)	CG (n = 22)	$p \leq$	ES
RP				
1-RT	8.06±6.45	6.46±5.28	0.322	0.134
2-RT	11.82±7.16	6.09±5.62	0.048*	0.407
NT	11.73±7.89	5.82±5.23	0.035*	0.405
TE				
1-RT	2.73±1.10	2.36±1.03	0.215	0.171
2-RT	2.72±1.10	2.01±1.01	0.041*	0.318
NT	2.55±1.13	1.64±0.67	0.032*	0.439

Note: * – $p \leq 0.05$ – (significance level); ES – effect size; RP – rank position; RT – regional tournament; NT – national tournament; TE – technical effectiveness.

No significant differences were reported between both groups in RP and TE mean values during the first 2-weeks in short competition cycle (first regional combat sambo tournament). Particularly, in EG and CG increases in RP and TE mean values ability were reported with a trivial increase ($ES < 0.25$). In contrast, there were significant ($p \leq 0.05$) differences in RP and TE mean values between both groups in last 2-weeks in competition cycle (second regional combat sambo tournament and one national combat sambo tournament), figure.

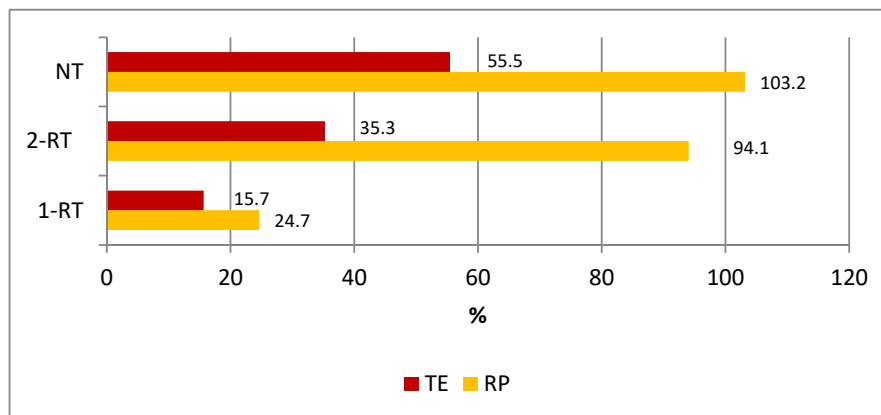


Fig. Increase in RP and TE values in EG athletes compared to CG athletes after 1-RT, 2-RT and NT Combat athletes (EG), who practiced specific FT intervention, demonstrated a significant ($p \leq 0.05$) higher in RP points and TE mean value, compare to other combat athletes (CG). For these findings, an increase small in performance was reported in EG ($ES < 0.25-0.50$).

Discussion

This scientific research investigated to association between short-term (4-weeks) FT intervention (based on CrossFit® training) and athletic performance of elite combat sambo athletes in following short competition period (4-weeks). Part of participants (EG) were submitted to a specific FT intervention and then participated in three combat sambo tournaments during the 4-weeks in competition cycle (November – December, 2022). Other participants (CG), who participated in these competitions, were not submitted FT intervention and applied traditional training in their training routine. In this research was partially support hypothesis on strong effect of short-term FT intervention (based on CrossFit® training) on athletic performance of elite combat sambo male athletes. Among the main findings, no significant differences were reported in athletic performance values (RP and TE) analysed between the groups in the first 2-weeks during the competition cycle. Combat athletes (CG), who don't applied FT intervention, demonstrated a similar athletic performance value (RP and TE) in the first regional combat sambo tournament during the 2-weeks in short competitive cycle. However, there were significant ($p \leq 0.05$) differences in athletic performance values (PotAS RP and TE) analysed between the groups in the last 2-weeks in short competition period. Combat athletes (EG), who submitted short-term FT intervention, demonstrated a higher mean value in RP and TE scores in the second regional and one national combat sambo tournament.

Kostikiadis, et al. (2018) indicate that the 4-weeks training program, including mainly using circuit training, did not improve upper and lower body strength and power of MMA athletes. *Ojeda-Aravena, et al.* (2021) reported that the special addition to regular training of a HIIT protocol with specific techniques and based on the temporal structure of combat after 4-weeks was not a sufficient stimulus to increase jumping ability and change of direction speed in elite karate athletes. *Kostikiadis et al.* (2018) provides strong evidence that a sport-specific low volume, high-intensity strength and conditioning training program, designed according to the demands of MMA competition, results in large improvements of MMA related fitness parameters, in trained MMA athletes. However, these conclusions were made only based on the results of one competition or non-competition results of specific physical fitness test battery in participants. This investigation provides strong evidence on the impact short-term FT intervention on athletic performance in elite combat sambo athletes in short competition cycle (three tournaments during the 4-weeks). The effects of this FT intervention result in large improvements of important athletic performance (RP and TE) values in elite combat sambo athletes post 2-weeks in short competition cycle.

Barley, & Harms, (2021) reported that there is a lack of research that has investigated the training habits of combat sports athletes at different values in the competition cycle (eg. in regular training or prior to competition). Further, little is known about the influence of factors such as the type of combat sports (eg. boxing compared to wrestling) and current level of competition (eg. elite and sub-elite compared to amateurs) on training habits as well as competition history and outcomes. Investigators reported that it is not known whether wrestlers are training more frequently before a competition than MMA fighters and whether elite combat sports athletes train more frequently in general and before a competition than amateur athletes. This investigation provides important information on effect of short-term FT intervention protocol (based on CrossFit® specific training) on athletic performance of elite combat sambo male athletes in short competition cycle (4-weeks). This scientific work provides full information on training program, frequency of training, training loads in elite combat sambo athletes in pre-competition and short competition period, included the three combat sambo tournaments. Such information can be used to understand the developmental trajectories of elite combat sambo athletes, inform training program design and improving competitive outcomes.

Kotarska et al. (2019) observed that most competitive combat sports athletes trained three – seven times a week. *Barley & Harms,* (2021) state that MMA athletes typically have approximately four combat training sessions and three strength and conditioning training sessions per week. Further, elite athletes do more training than did sub-elite athletes and amateurs. Also, MMA athletes do more combat sports training sessions per week than the judo and striking athletes. The frequency of combat sessions increasing when a competition is coming up. This investigation shown that male elite combat sambo athletes generally complete more combat sessions per week (10 training sessions per week) than other combat sports (eg. judo and striking combat sports), with a competition coming up, which may be a result of the wider range of combat skills (both striking and grappling) that they must practice successfully.

Conclusions

This investigation demonstrated that a 4-weeks FT intervention based on CrossFit® specific training does not report significant differences in athletic performance (RP and TE) compared to traditional pre-competition training in elite combat sambo athletes during the first 2-weeks in short competition cycle (4-weeks). However, there were significant differences in athletic performance (RP and TE) in favor athletes (EG) who applied FT intervention, in last 2-weeks in short competition cycle. Although it requires further investigations, the incorporation of short-term FT protocols with specific training programs could be an alternative as part of the training session during pre-competition periods due to the limited time available to

combat athletes to cope with the demands of this period. Therefore, it is recommended to elaborate individual FT protocols that would improve the combat sambo athletes' physical fitness and sport performance.

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Conflicts of interest.

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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