Firefighter force preparation for hookladder tower assault event

Abstract

The training schedule recommends the use of preparation models with a specialization in their content, volume and organization. In this direction, there are inadequacies in the preparation of the firefighters' force preparing for technical skills competitions. The investigation faces this problem, and the objective is to define the programming of the preparation of the firefighter's force for the assault on the tower with a hook ladder. A diagnosis is made through document analysis, surveys, observations and methodological workshops. Finally, it provides such programming for the preparation of strength in this discipline. The results establish: the temporal distribution of force preparation in a macrocyclic structure, the links and interrelationships of the different manifestations of force, as well as the interrelation of the load indices in the macrocycles and auxiliary exercises. Its application is exposed in the Villa Clara team that is preparing for the Firefighter's Technical Skills competitions. The programming of the defined force preparation, guarantees the increase of the competitive performance state of the firefighters during the different moments of the preparation cycles, causing the increase of the sporting results.

Keywords: *Strength preparation; firefighters; training schedule; assault on the tower*

Introduction

The professional firefighter is a prepared person, who is not only dedicated to extinguishing fires, but also attends all kinds of interventions, such as accidents, rescues or activities with pyrotechnics, among others. Must possess the necessary skills and abilities to solve any emergency situation (Cabezos and Fernández 2016); (Footwear, 2018), that is why members of the fire department require excellent physical condition, similar to those of athletes.

The afore mentioned made the directors of this body of the Cuban Ministry of the Interior think about incorporating the skills of Technical Skills of the Firefighter (TSFf) from 1967, with the purpose of perfecting the capacities and abilities of its members, for a confrontation more efficient, which would also make it possible to systematically assess operational capacity and maintain a spirit of constant self-preparation.

In TSFf competitions that have been held nationwide since 1993, discipline number IV concerning speed exercises with stairs, has two events:

• Assault on the tower with a hookladder (individual).

• Assault on the tower with a three-section ladder (collective).

These exercises have the objective of evaluating the ability of the firefighter during the climb, in them the firefighter is placed with the regulation uniform and helmet, 32.5 meters from the three-floor tower. At the start voice the firefighter must run with the ladder and climb floor to floor until entering the third balcony. During the climb, you must comply with the safety regulations, taking the steps and never the stringers of the ladder. The entrance to the third floor can only be executed with the feet, prohibiting another type of form, the final time of the exercise will be taken when the competitor rests both feet on the balcony floor. (Figure 1).

Figure 1. Competences of "Technical Skills of the Firefighter" (TSFf)

If the referee of the event observes indecision, violation of the security measures or lack of mastery of the technique, he may stop the exercise and order disqualification, it is a discipline that requires a great physical condition, which forces the firefighter to carry out a process preparation similar to any sports activity.

It is for the foregoing that he must, in his training, emphasize the different components of sports preparation and in their organization, for this reason in the physical preparation of the firefighter, the preparation of strength is considered a basic and determining component, this should be seen as the rational use of all factors (means, methods and conditions) that allow a targeted influence on the growth of muscle strength (González, 2017). Muscle strength is developed by different sports, mainly using weightlifting as an auxiliary sport.

At the international level, there are a series of guidelines on the preparation of fire brigades, such is the degree thesis by Rivas and Zhiminay (2015), in which a training plan for the fire brigade of the Sígsig canton in Ecuador is proposed. , organized from the block model, however, it only recommends the development of force through

planks, sit-ups, jumps, and only uses squats and lying force as preparation for force with weights, not describing the way of planning it.

Also in this direction Casado (2016) offers a series of recommendations for the preparation of firefighters, emphasizing the work of the force and its combination with the life regime, in his work he does not offer which components of the load to dose, nor how organize such preparation.

For its part, the National Academy of Firefighters of Chile (2017) in its manual of health and physical activity of the firefighter, offers the proposal of routines for the work of the force, this is limited in the recommendations for the preparation with weights, makes reference only to natural exercises among which planks, abdominals, tractions are observed.

Castillo (2017) proposes a group of exercises for the development of physical capacities in firefighters, considering that the exercises must refer to those that are applied in the place of the fire, and describes them in a way that allows, on the one hand, to prevent injuries and on the other, the performance of specific activities.

In this same direction, Senfet (2016) refers to the importance of training all physical capacities, especially strength due to the functions it must perform, such as moving equipment and forcing doors. This author proposes a squat and chin-up circuit in which the maximum possible repetitions should be performed in each exercise using full personal protective equipment. These authors limit the proposal to exercises independently without dosages or periodization of strength training.

Toledano (2018) proposes an exercise scheme, in which it includes different actions with running combined with strength exercises, including forearm, chin-ups, work with rubber bands and others, but it is only limited to organizing weekly work. In the same sense, Cortina (2021) refers to the physical tests to be carried out by firefighters and proposes an organization of training. In both cases this planning is limited to the work of the week.

Regarding planning in longer periods of time, two articles by Manuel Jiménez are observed on the site "Physical preparation of the firefighter". In the first of them (Jiménez 2018 a) he proposes different blocks for the development of physical preparation, among them a nonspecific or leveling physical condition block that covers 5 to 10 weeks, which focuses on strength work Basic, then a specific block or special work from 12 to 19 weeks, finally a competitive or exam block, is the test execution block, therefore the intensity will be the maximum assimilable.

In his second article Jiménez (2018 b) presents the differences between the concept of strength and muscular power within the physical preparation for firefighters, and on the importance of differentiating between the eccentric and concentric phase of the exercises in their physical preparation. It has two phases, a first one of physical condition in which one must simply seek to increase a basic muscle tone and a second one of accumulation of work and increased levels of strength and power, in which the number of repetitions and series must be lowered. Both items, but refer to planning longer periods of time, generally do not address scheduling loads.

In research cited, despite its great importance, not the aspect of the organization and structuring of the preparation of the force is discussed in terms of their timing, and their relationship and interconnection of different manifestations specifically for exercise assault on the tower with ladder hook.

According to the previous situation, it is pursued objective: defining programming preparation firefighter force for the assault on the tower with ladder hook.

Methodology

We worked with two populations, one of 5 TAFf trainers and the other, of the 16 trainers of the province of Villa Clara from which an intentional sample of six specialists was selected, due to their great experience in this work.

Different methods were used in conducting the research, which are set out below.

The analysis of documents: The documents that regulate and project the preparation of firefighters participating in TAFf competitions were consulted, of which the Study Program of Specialized Preparation of Firefighters (SPSPFf) for the year 2019.

It was analyzed the training plan of the TAFf team of the province of Villa Clara in 2018 and the analysis reports of the results of the preparation and TAFf competitions were reviewed.

Observation: A total of 12 observations were made to the sessions, they were made in the general and special preparation stages, six corresponded to the general preparation stage and six to the special preparation stage. Climbing exercises, volume and intensity control were observed according to the type of force, the relationship between the climbing exercises with the ladder and the auxiliary ones for strength and how the individualization of the training was carried out.

The survey: Its application allowed to collect general criteria on the preparation of the force, its conception, functionality and systematization. It was applied to two TAFf trainers from the province of Villa Clara, intentionally selected for being the ones who started this type of preparation, already retired, and the four TAFf trainers from the province of Villa Clara who work this activity in the municipalities.

Methodological workshops: Two methodological workshops were held, the objective of which was to determine the characteristics and essential criteria of content and organization of the preparation of the force in the training of firefighters to assault the tower with a hook ladder. In the first workshop, the planning structure and distribution over time based on TAFf's competencies were determined. The second workshop establishes the succession between the manifestations of force in the macrocycle and the mesocycles, the components of the load according to the characteristics of the macrocycle, as well as the methods and means to be used.

Results and Discussion

Diagnosis results

The analysis of documents allowed us to appreciate the scarcity of guiding content to carry out a correct organization of the preparation of the force in the firefighters to assault the tower with a hook ladder, taking into account the planning structure and the succession of the different manifestations of strength, this forces coaches to use empirical methods to organize strength training.

The Firefighter's Specialized Physical Preparation Program (2019) conceives that they should increase the levels of physical preparation to act in the commands and in the units, it emphasizes the improvement and development of TAFf, through the progressive development of skills. basic motor skills and sports and conditional capacities, but it is insufficient in the organization, structuring and control of the loads to be applied for the development of strength. In addition, in most commands and units, as a general rule, physical preparation is left to the free choice of each firefighter.

The physical preparation in the training plan does not contemplate the preparation of strength with weights, only the technical work of climbing and some elements of the preparations of resistance and speed. Strength preparation is not planned or controlled, only some strength exercises such as tractions and parallels for strength are performed on the day that the coach considers it.

In the reports of analysis of the results of the preparation and the TAFf competitions, the importance that should be given to the strength preparation for this type of competitions is not evident, so the recommendations made for this purpose are non-existent.

In the observation of the training sessions, the modification of the exercises in the succession of the training sessions was not evidenced, a repetition of the exercises was observed in the training sessions of the different moments of the preparation, which limits the necessary variability of the training sessions in order to achieve the increase in strength, deficiencies in the control of volume and intensity in exercises with weights, the musculature that intervenes in the climbing exercise towards which they should be directed is not considered.

The main difficulties observed were in:

• Free performance and selection of the exercises by the firefighter, so there is no variability in the exercises and ignorance of the type of force that is performed.

• In general, they all perform the same exercises, there is no individualization of these, nor the necessary relationship between the climbing exercises with the ladder and the auxiliary ones for strength.

• The few auxiliary exercises they do for strength are performed with insufficient repetition and no intensity control.

• Recovery between batches is sometimes very extensive.

• No tests are carried out to control the preparation of the force.

About the results of the survey: In the first question, regarding the location of the strength preparation, it was obtained that 100% of the respondents reflect their location at the end of the training. In the second question regarding the knowledge and location of the types of force by stages, 50% consider that there is ignorance and this is not reflected in the PPPFf. The third question referred to the division of the volume by planes, 80% answered that they did not divide it, 50% emphasized the technical preparation and did not receive a correct methodological orientation for the preparation of the force.

In the fourth question of the survey, 50% state that they do not know the type of force that the firefighter is working on in the training session.

In the fifth question, 50% do not include in the plan the types of strength, volume and intensity with which they will work for each month. The sixth question that asks about

how to plan the strength of their firefighters, 100% state that they do it freely or under their guidance, on the basis of the exercises that they like the most. In the seventh question, 100% show the lack of guidelines to develop the preparation of muscular strength. 100% declare in the eighth and ninth question that the load to be used does not appear, although some exercises for the preparation of strength do.

The results obtained from the diagnosis in the first stage of the research, reaffirm the need to modify the conception of training, especially in the programming of strength preparation, as well as organize said preparation in a planning structure that guarantees in training the correct succession of the different manifestations of strength as the preparation progresses.

Results of the workshops: The results of the first workshop allowed arriving at the planning structure according to the new competitive TAFf system and the establishment of the manifestations of force, leaving the structure as shown in figure 2.

Modelo Nº. 1 *MACROCICLO DE PREPARACIÓN DE FUERZA.*

Centro: Disciplina: Año:

Macrociclos	I												II											
Períodos	PREPARATORIO						COMPT		TRANST				PREPARATORIO											COMPT
Etapas	General				Especial			Competitiva		Tránsitoria			General								Especial			Competitiva
Mesociclos	1				2			3		4			5	6			7			8		9			10			11			12			
Meses	Dic				Ene			Feb		Mar			Abr	May			Jun			Jul		Ago			Sep			Oct			Nov			
Microciclos	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Días																																															
Tipo de Fuerza	*Resist Fza*				*Resist Fza*				*Fza Ráp*				*Fza Ráp*				*Resist Fza*				*Resist Fza*				*Fza Ráp*				*Fza Ráp*				*Fza Ráp*				*Fza Máx*				*Fza Ráp*				*Fza Ráp*				*Fza Ráp*			

In the second workshop, the calculations are made through the methodology of González (2017), leaving the volume to work according to the types of force as they appear in table 1. For the relative average intensity (RAI) the coaches refer to taking the table by types of force proposed by this author, taking the percentages of intensity, from 40 to 60% for resistance to force, from 65 to 85% for fast force and from 90 to 100 for maximum force.

Table 1. Volume to work according to the types of force

MESOCICLOS	RESIST. FZA.	FZA. RÁPIDA	FZA. MÁXIMA
2 Microciclos	330-600	300-570	270-540
3 Microciclos	495-900	450-855	405-810
4 Microciclos	660-1200	600-1140	540-1080

Regarding the methods, it was considered to use the method by types of force used by González (2017), always with strict control and according to the individual needs of the firefighters. It was determined that the proposed maximum results method is the fundamental one due to its easy application.

The media starts with the selection of exercises with weights, carrying out a kinetic study of the assault on the tower with a hook ladder, considering the movements of the articular axes, which allows determining the agonist and antagonist muscles that intervene in each part of the movement (starting, running, lifting the implement, hitching, ascent, take out and hitch, jump and ascent, entrance to the balcony). Allowing later to make a selection of auxiliary exercises to develop said musculature considering the proposal of Román (2011). Remaining the programming of the loads as follows:

Macrocycle I was made up of 20 microcycles, distributed in 2 mesocycles for general stage with 8 microcycles for resistance to strength, (Figure 3) its dosage is 1 to 3 series with 8 to 10 repetitions and breaks of 1 to 3 minutes. . The special stage with 4 microcycles for rapid strength, its dosage is 1 to 4 series with 3 to 5 repetitions and breaks between 1 and 3 minutes.

Macrociclos		I																	
Períodos		PREPARATORIO												COMPT				TRANST			
Etapas		General								Especial				Competitiva				Tránsitoria			
Mesociclos		1				2				3				4				5			
Meses		Dic				Ene				Feb				Mar				Abr			
Microciclos		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Dias																					
Tipo de Fuerza		Resist Fza				Resist Fza				Fza Ráp				Fza Ráp				Resist Fza			
Vol del Meso		1020				900				700				600				1000			
Int. del Meso%		40-50				50-60				65-75				75				50-60			
Vol (%)	Brazos	40				30				40				35				40			
	Tronco	20				40				25				30				20			
	Piernas	40				30				35				35				40			
Controles		*												CC				*			

Figure 3. Cargo volume and IMR of macrocycle I.

The dosage of the competitive stage with 4 microcycles for fast strength, was with 1 to 4 series with 3-5 repetitions and breaks between 1 and 3 minutes. The transit stage, with 4 microcycles for resistance to strength, will serve as a rest and at the same time a basis to face the next cycle of the 2019 macrocycle. The essence of this phase was to work most of the muscle groups and prepare ligaments, tendons and joints for subsequent phases.

Macrocycle II, had 28 microcycles, distributed in 4 mesocycles for general stage with 4 microcycles for resistance to strength, its dosage is 1 to 3 series with 8 to 10 repetitions and rest of 1 to 3 minutes, 8 microcycles continue of rapid force, (Figure 3) with dosage of 1 to 4 series of 3 to 5 repetitions, culminating the stage with 4 microcycles of maximum force with repetitions between 1 to 3 and series between 1 and 2 and breaks of 1-3 minutes.

II																							
PREPARATORIO																				COMPT			
General														Especial						Competitiva			
6				7				8				9				10				11				12			
May				Jun				Jul				Ago				Sep				Oct				Nov			
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Resist Fza				Fza Ráp				Fza Ráp				Fza Máx				Fza Ráp				Fza Ráp				Fza Ráp			
950				900				940				300				900				700				600			
55-60				65-75				75-85				85-95				70-80				75-85				65-75			
40				30				30				40				25				40				35			
20				40				40				20				35				25				30			
40				30				30				40				40				35				35			
															*												CF

Figure 4 Cargo volume and IMR of macrocycle II

The special stage with 8 microcycles for fast strength, with dosages of 1 to 4 series of 3 to 5 repetitions, with rest between 1 and 3 minutes. The competitive stage with 4 microcycles for fast strength, its dosage is between 2 and 4 repetitions per series and these between 1-3, with rest between 1 and 3 minutes. The essence of this phase was to continue strengthening the muscle groups for the correct execution of the climbing exercise.

Table 2 shows the results of the strength tests, the standing force increased the mean values in the 3 measurements made, occurring in the same way with the squat from behind and the takeoff with flexion. The values in the coefficient of variation are shown in normal ranges, demonstrating the influence of training in the generality of firefighters.

Table 2. Descriptive results of the maximum results test

Fza. Parado	X	Mín.	Máx.	Ds	CV
M1	42,33	28,00	50,00	10,57	24,97
M20	44,16	32,00	52,00	10,42	23,59
M36	47,16	33,00	55,00	9,36	19,84
Despegue C/F	**X**	**Mín.**	**Máx.**	**Ds**	**CV**
M1	61,00	44,00	73,00	13,25	21,72
M20	61,33	46,00	75,00	12,99	21,18
M36	63,50	49,00	78,00	12,35	19,44
Cuclilla x Dtrás.	**X**	**Mín.**	**Máx.**	**Ds**	**CV**
M1	88,16	75,00	95,00	9,91	11,24
M20	92,33	80,00	102,00	11,32	12,26
M36	98,66	87,00	105,00	9,26	9,38

Symbology: (X) Mean, (Ds) Standard deviation, (CV) Coefficient of variation. (M1, M20, M36) Microcycle 1, 20, 36.

An increase in the mean values was generally observed in each of the tests carried out in the different microcycles that were controlled. This, together with the acceptable percentage values in the coefficient of variation, speaks positively of the use of the designed force programming.

The results on the preparation of the strength are associated with the results of the controls at the times in the performance of the exercise, these controls were carried out in the microcycles 9, 12, 28, 33, 40 and 44, always after the controls of the strength. The behavior is as it appears in table 3:

Nombre y Apellidos	MACROCICLO I						MACROCICLO II											
	M-9			M-12			M-28			M-33			M-40			M-44		
	T-1	T-2	Prom	T-1	T-2	Prom	T-1	T-2	Prom	T-1	T-2	Prom	T-1	T-2	Prom	T-1	T-2	Prom
Eslan Ulacia Machado	19.15	20.13	19.64	17.30	17.08	17.19	18.02	18.90	18.46	18.05	18.35	18.20	17.35	17.48	17.42	17.00	16.60	16.80
Luís Enrique Castellano	19.35	19.80	19.58	17.00	17.35	17.18	20.15	19.45	19.80	19.10	18.35	18.73	17.06	17.60	17.33	16.25	17.00	16.63
Fernando González Gallo	20.65	21.00	20.83	18.20	18.00	18.10	19.73	20.10	19.92	17.60	17.10	17.35	16.80	17.25	17.03	15.80	16.35	16.08
Marcos Gel Bravo	20.01	20.09	20.05	18.35	17.55	17.95	20.50	19.90	20.20	19.01	18.40	18.71	17.40	17.65	17.53	16.00	16.40	16.20
Aron Arocha Prada	18.40	19.22	18.81	17.50	18.15	17.83	18.95	19.35	19.15	17.60	17.25	17.43	16.50	16.95	16.73	16.10	15.45	15.78
Promedio	19.51	20.05	**19.78**	17.67	17.63	**17.65**	19.47	19.54	**19.51**	18.27	17.89	**18.08**	17.02	17.39	**17.20**	16.23	16.36	**16.30**
Desviación	0.86	0.64		0.58	0.45		1.00	0.47		0.74	0.66		0.38	0.29		0.46	0.57	

Table 3. Behavior of the times in the execution of the tower assault exercise

T1 corresponds to the execution of the exercise in the right lane and T2 to the execution of the exercise in the left lane, in the competition the shortest of the times is taken, while for the training they are averaged as a way of control.

Table # 3 shows in a positive way the influence of the preparation of the force in the competitive result in the event of assault on the tower with a hook ladder, from the use of the proposed exercises.

Conclusions

Difficulties are observed in the temporal distribution, and the succession of the different manifestations of the organization of the preparation of the force, as well as a limited specialization of the means used.

The programming of the preparation of the force for the firefighters in terms of its content, volume and organization, as well as the criteria of its temporal distribution in a classical structure and the determination of the succession of the manifestations of the force, facilitated the distribution of loads and their dosage in the macrocycle and their corresponding mesocycles.

The implementation of the force preparation programming, guaranteed an increase in the competitive performance status of the firefighters during the different moments in the macro-cycle of preparation, causing an increase in sporting results.

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