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Original article

EFFORT VOLUME AND INTENSITY INDICATORS ON JUNIOR RHYTHMIC GYMNASTS - 2ND LEVEL (11-12 YEARS) - CASE STUDY

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Abstract

Aim. Athletes' preparation for competitions has always been accomplished through training. Rhythmic gymnastics, like any other sport discipline, has a specific training that approaches different volumes and intensities, depending on the training stages: preparatory, precompetitive or competitive.

The current paper aims to highlight and analyze the effort parameters in performance rhythmic gymnastics training, in terms of volume and intensity of effort.

Methods. The research was conducted on an individual rhythmic gymnast, aged 11. For a period of eight weeks, we monitored the volume of the effort, in terms of duration, frequency and distances, as well as the intensity of the effort, in terms of distance traveled during a specific time and heart rate.

Results. The results show that during the entire training programme, the subject participated in 53 training sessions, summing up 159 hours of training, during which she performed 384 half routines and 332 complete routines without musical accompaniment, amounting 9,6 hours for half routines and 15,3 hours for complete routines; 192 half routines and 156 complete routines with music, summing up a duration of 2,32 hours for half routines and 3,77 hours for complete routines; the distance travelled was 40391.6 m during routines performed without music and 17799 m during routines performed with music; the heart rate after two linked routines, with a rest of 30s between them was situated between 164-177 bpm.

Conclusions. The levels of volume and intensity vary from one training period (e.g. preparatory) to another (e.g. precompetitive). Such an analysis may highlight, depending on the gymnast's results in competitions, whether the planning is productive or not.

Keywords: training; effort; volume; intensity; planning; performance.

Introduction

Rhythmic gymnastics is a unique and captivating discipline that seamlessly merges artistic expression with athletic prowess, characterized by a high level of elegance, grace and artistic expressivity, "that combines technical, aesthetic, and artistic parameters with the aim of reproducing an optimal execution model, both in matter of form and execution" (DíazPereira et al., 2014). Rhythmic Gymnastics refers to a sport that combines elements of dance, ballet, and gymnastics. It involves graceful and rhythmic routines performed with various handheld apparatus, such as ribbons, hoops, balls, clubs, and ropes in complete harmony with the musical accompaniment. (Martin, J. 2001, Aleksandrova, E. 2010). Rhythmic gymnastics is "a complex artistic and aesthetic sport with a particular training process and which demands high levels of physical and psychological stress in competition" (Bobo-Arce & Méndez-Rial, 2013).

In Rhythmic Gymnastics there are 2 types of events, the individual that involves solo performances by gymnasts, where they perform routines with various apparatus while showcasing their technical skills, flexibility, and artistry. And the group event involves a team of gymnasts, typically five to six, who perform synchronized routines using the same apparatus. Coordination and teamwork are crucial in this category. (Ivanova, A. 2010, Viner-Usmanova, I. 2014, Maksimova, L. 2017, Donskaya, N. 2009, Burgina, A. 2015, Yaroshenko, E. 2018).

The floor area used is 13x13m (exterior of the line) is compulsory and. Routine length for the individual event is between 1.15 minutes and 1.30 minutes and for the group event between 2.15 minutes and 2.30 minutes. The elements of sports rhythmic gymnastics have been determined by Code Of Point 2022. During the Olympic cycle, the Federation Internationale de Gymnastique (FIG) decides which are the 4 of the official 5 apparatus will be used at the international level of competition, and also the rules for scoring in rhythmic gymnastics are revised every four years after the Olympic Games. Obtaining a high score in competition is the purpose of a successful performance (El-Hamid, R., 2010, Eman, A.A. and F.K. Naglaa, 2010)

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Batista, Gomez, Garganta & Avila Carvalho (2018) quote Berlutti et al. (2010), who consider that the training volume in rhythmic gymnastics has increased in recent years. Elite gymnasts train 25-30 hours per week and, in some cases, 40 hours per week to achieve the essential preparation for a good performance, due to the high physical and technical requirements in this sport discipline (Ávila-Carvalho et al., 2013 & Zetaruk et al., 2006 quoted by Batista et al., 2018). For junior gymnasts, it is suggested a weekly volume between 12 and 18 hours (Leandro, Ávila-Carvalho, Sierra-Palmeiro, Bobo-Arce, 2016).

As far as the effort in sports training is concerned, authors Matveev and Novikov (1980), state that “the effort is first of all the quantitative indicator of physical exercise, being directly related to the expense of the working potential of the body and its fatigue”.

The effort is characterized by indicators such as specificity, volume, duration, amplitude, density, intensity and complexity. (Platonov, 2015)

Bompa (2009) describes the volume of effort in sports training as the total quantity or volume of training that an athlete undergoes. It encompasses the workload, repetitions, and duration of training sessions over a specific period. Dantas (2003), quoted by Batista et al. (2018) points out that volume is the training quantity (number of training hours, number of exercises, number of repetitions per exercise, distance traveled, etc.) and intensity is the training quality (speed, space, rest time – passive or active rest, amplitude of movements, etc.). Petrov (2016) describes the volume of effort in rhythmic gymnastics as total quantity or volume of training and practice that gymnasts undergo to develop their skills, routines, and overall performance. It encompasses the hours, repetitions, and intensity of training sessions, which are critical for mastering the intricate movements, apparatus handling, and artistic elements of rhythmic gymnastics. Dantas (2003), quoted by Batista et al. (2018) points out that volume is the training quantity (number of training hours, number of exercises, number of repetitions per exercise, distance traveled, etc.) and intensity is the training quality (speed, space, rest time – passive or active rest, amplitude of movements, etc.). The findings of a study conducted on Olympic and International gymnasts showed that the subjects reported that the practice of technique and routine training required more physical effort and mental concentration than warm-up, ballet, and conditioning (Law, Côté, & Ericsson, 2007). Batista, Gomez, Garganta & Avila Carvalho (2018) quoted Berlutti et al. (2010), who consider that the training volume in rhythmic gymnastics has increased over the recent years.

Blanco Nespereira (2011) considers that it is very important that routines with different apparatus do not resemble, so when the spectator watches the exercises he will be surprised, as they witness a combination of body skill elements and apparatuses techniques that is characteristic and unique to that apparatus.

The findings of a study conducted on Olympic and international gymnasts showed that the subjects reported that the practice of technique and routine training required more physical effort and mental concentration than warm-up, ballet, and conditioning (Law, Côté, & Ericsson, 2007).

Arango Blanco & Govea Diaz, (2018) point out that “the control of the intensity of the training of competitive exercises during the special preparation or microcycles of transformation, is an aspect that is hindered by the non-definition of indicators to be taken into account in the rhythmic gymnastics related to the characteristics of the load (external and internal) and the results to be achieved by the gymnasts”.

Also concerning the intensity of the effort, in terms of heart rate (HR), a study conducted by Vancov and Vancova (1994), according to whom, in the basic training for the improvement of the object manipulation technique, the HR was situated between 115-125 bpm, in the classical dance programme the HR was between 140-160 bpm., while in the training where the routines were executed at a level close to the competition one the HR was between 165-195 bpm. Following these data, Manos (2008) concluded that the competition effort in rhythmic gymnastics is of “submaximal intensity with maximum intensity peaks”. On the same topic, Ávila-Carvalho & Lebre (2011) state that “the routines in rhythmic gymnastics have a short duration and the exercise intensity is maximum in some moments, thus it is not continuously submaximal or maximal, as in cyclic sports”.

Objectives

The current paper aims to highlight and analyze the effort parameters in performance rhythmic gymnastics training, in terms of volume of the effort, duration of the effort - through the effective repetition time of the routines, frequency – through the number of routines performed and distances reached during the routines, as well as in terms of intensity of effort, expressed through the speed in execution - distance reached within a specific time, but also by measuring the heart rate of the gymnast, in different key moments of rhythmic gymnastics training.

Methods

The research was conducted at the Sports School Club of Constanta, Romania, in 2021, on an individual gymnast (name I.C.), age 11, weight 27 kg, height 138 cm, BMI 14.2, component of the rhythmic gymnastics juniors team, 2nd level – 3rd category.

In order to increase the sports performance of the subject, her coach developed a training plan, scheduled for eight weeks (May-June. 2021), during which the gymnast completed the following training periods: preparatory - two stages (four weeks), precompetitive I (one week), competitive I (one week - National Scholar Championship), precompetitive II (two weeks), competitive II (one week).

The planning covering these training periods amounted to a total of 54 training sessions, 24 training sessions per preparatory weeks, 18 training session/ precompetitive weeks and 12 session training/ competitive periods, summing up 162 hours of training. Every day, except for the choreographic programme, the repetition of the difficulty elements and the physical training programme, the gymnast refined her competition routines for two of the four compulsory apparatuses (hoop and ball each Mondays, Wednesdays, Fridays and clubs and ribbon each Tuesdays, Thursday, Saturday). Within the precompetitive periods, on Saturdays, there were organized simulated competitions, the gymnast performing routines with each of the four apparatuses. On Sundays, the gymnasts benefited from a rest break.

For the elaboration of this paper, we monitored the training of the subject, recording accurate data for each indicator that we aimed to analyze. Thus, we recorded the volume of effort, in terms of:

- number of training hours (per training period/training plan);
- number of repetitions of half/complete routines, with/without musical accompaniment (per training period/training plan);
- duration of repeating half routines/complete routines with/without musical accompaniment (per training period/training plan);
- percentage of time spent on repetition of routines during each training period;
- distance reached during a half routine/complete routine (per training period/training plan);

Intensity of effort, in terms of the following:

- distance traveled while performing half/complete routines, with musical accompaniment, in a specific time (m/s);
- heart rate.

In order to register the data mentioned above, we used a chronometer to record the duration of repetitions of half/complete routines, a laser telemeter to track the distance travelled during a half/complete routine and a finger heart rate monitor to record the heart rate of the subject in key moments of the training session.

Results

For the elaboration of the current study, we recorded data for each of the training periods in Table 1.

Table 1. Training periods monitored during the research

Training period	Preparatory I st stage	Preparatory II nd stage	Precompetitive I	Competitive I	Precompetitive II	Competitive II
Duration	Two weeks	Two weeks	One week	One week National Scholar Championship	Two weeks	One week National Junior Championship
No. of training sessions	12	12	6	6	11	6
No. of training hours	36	36	18	18	33	18

The volume of effort – number of repetitions

Closely following the training plan developed by the gymnast's coach, there have been recorded the number of repetitions per training session and per training period, for each apparatus. The data are shown in Table 2, Table 3, 4, 5.

Table 2. No. of repetitions during the Ist stage of the preparatory period

Preparatory I st stage	No. of trainings sessions: 12, from which		Type of repetition (routine/ half routine)	No. of repetitions/day (without music)		No. of repetitions/day (with music)		No. of repetitions/training period (without music)		No. of repetitions/training period (with music)	
				1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd
				half	half	half	half	half	half	half	half
Two weeks	Hoop	6	½ routine	x8	x8	x4	x4	x48	x48	x24	x24
	Ball		½ routine	x8	x8	x4	x4	x48	x48	x24	x24

	Clubs	6	½ routine	x8	x8	x4	x4	x48	x48	x24	x24
	Ribbon		½ routine	x8	x8	x4	x4	x48	x48	x24	x24

Table 3. No. of repetitions during the IInd stage of the preparatory period

Preparatory II nd stage	No. of trainings sessions: 12, from which		Type of repetition (routine/half routine)	No. of repetitions/day (without music)	No. of repetitions/day (with music)	No. of repetitions/training period (without music)	No. of repetitions/training period (with music)
Two weeks	Hoop	6	routine	x6	x4	x36	x24
	Ball		routine	x6	x4	x36	x24
	Clubs	6	routine	x6	x4	x36	x24
	Ribbon		routine	x6	x4	x36	x24

Table 4. No. of repetitions during the Ist precompetitive period

Precompetitive I	No. of trainings sessions: 6, from which		Type of repetition (routine/half routine)	No. of repetitions/day (without music)	No. of repetitions/day (with music)	No. of repetitions/training period (without music)*	No. of repetitions/training period (with music)*
One week	Hoop	3	routine	x6	x2	x22	x7
	Ball		routine	x6	x2	x22	x7
	Clubs	3	routine	x6	x2	x16	x5
	Ribbon		routine	x6	x2	x16	x5
+ 1 Competition trial, during which the gymnast executed 1 routine with each apparatus (no. of routines rehearsed without music during the competition trial: 4 repetitions for each apparatus)							

*in the total no. of repetitions/training period, are also included the no. of routines performed during the competition trial

Table 5. No. of repetitions during the IInd precompetitive period

Precompetitive II	No. of trainings sessions: 9, from which		Type of repetition (routine/half routine)	No. of repetitions/day (without music)	No. of repetitions/day (with music)	No. of repetitions/training period (without music)*	No. of repetitions/training period (with music)*
One week	Hoop	4	routine	x6	x2	x28	x9
	Ball		routine	x6	x2	x28	x9
	Clubs	4	routine	x6	x2	x28	x9
	Ribbon		routine	x6	x2	x28	x9
+ 1 Competition trial, during which the gymnast executed 1 routine with each apparatus (no. of routines rehearsed without music during the competition trial: 4 repetitions for each apparatus)							

*in the total no. of repetitions/training period, are also included the no. of routines performed during the competition trial

The volume of effort – duration of repetitions

In correlation with the number of repetitions, we calculated the duration of the effort during each training period [Table 6, 7, 8, 9].

Table 6. Duration of effort during the Ist stage of the preparatory period

Preparatory I st stage	No. of trainings sessions: 12, from which	Duration of a routine (s)	Duration of rehearsal of routines/day (without music)* (s)		Duration of rehearsal of routines/day (with music) (s)		Duration of rehearsal of routines/training period (without music) (s)		Duration of rehearsal of routines/training period (with music) (s)		
			1 st half	2 nd half	1 st half	2 nd half	1 st half	2 nd half	1 st half	2 nd half	
Two weeks	Hoop	6	87	720	720	174	174	4320	4320	1044	1044
	Ball		86	720	720	172	172	4320	4320	1032	1032
	Clubs	6	89	720	720	178	178	4320	4320	1068	1068
	Ribbon		87	720	720	174	174	4320	4320	1044	1044

* the durations of repetitions of executions performed without music was approximated at 1,5 minutes/half routine (90s)

Table 7. Duration of effort during IInd stage of the preparatory period

Preparatory I st stage	No. of trainings sessions: 12, from which	Duration of a routine (s)	Duration of rehearsal of routines/day (without music)* (s)	Duration of rehearsal of routines/day (with music) (s)	Duration of rehearsal of routines/training period (without music) (s)	Duration of rehearsal of routines/training period (with music) (s)	
Two weeks	Hoop	6	87	1080	348	6480	2088
	Ball		86	1080	344	6480	2064
	Clubs	6	89	1080	356	6480	2136
	Ribbon		87	1080	348	6480	2088

* the durations of repetitions of executions performed without music was approximated at 3 minutes/routine (180s)

Table 8. Duration of effort during the Ist precompetitive period

Precompetitive I	No. of trainings sessions: 6, from which	Duration of a routine (s)	Duration of rehearsal of routines/day (without music)* (s)	Duration of rehearsal of routines/day (with music) (s)	Duration of rehearsal of routines/training period (without music)** (s)	Duration of rehearsal of routines/training period (with music)** (s)	
One week	Hoop	3	87	900	174	3420	609
	Ball		86	900	172	3420	602
	Clubs	3	89	900	178	2520	445
	Ribbon		87	900	174	2520	435
+ 1 Competition trial, during which the gymnast executed 1 routine/apparatus (no. of routines rehearsed without music: 4 repetitions for each apparatus, with a duration of 3 minutes - 180s each)							

* the durations of repetitions of executions performed without music was approximated at 2,5 minutes/routine (150s)

**in the total duration of repetitions/training period, are also included the no. of routines performed during the competition trial

Table 9. Duration of effort during the IInd precompetitive period

Precompetitive I	No. of trainings sessions: 9, from which	Duration of a routine (s)	Duration of rehearsal of routines/day (without music)* (s)	Duration of rehearsal of routines/day (with music) (s)	Duration of rehearsal of routines/training period (without music)** (s)	Duration of rehearsal of routines/training period (with music)** (s)	
One week	Hoop	4	87	900	174	4320	783
	Ball		86	900	172	4320	774
	Clubs	4	89	900	178	4320	801
	Ribbon		87	900	174	4320	783

+ 1 Competition trial, during which the gymnast executed 1 routine/apparatus (no. of routines rehearsed without music: 4 repetitions for each apparatus, with a duration of 3 minutes - 180s each)

* the durations of repetitions of executions performed without music was approximated at 2,5 minutes/routine (150s)

**in the duration of repetitions/training period, are also included the no. of routines performed during the competition trial.

From the data presented, it can be observed that for routines performed without musical accompaniment, the time was approximated at 3 minutes/routine (87-89s routine; 93-91s waiting turn) in the preparatory period and 2,5 minutes/routine (87-89s/routine; 63-61s waiting turn) during the precompetitive periods. These durations have the following justifications:

(a) during the rehearsals without musical accompaniment, the subject of the research repeats her routines together with another five gymnasts, on the same carpet, sometimes having to wait a few seconds for the area toward which she has to move to become free;

(b) during rehearsals the gymnast receives corrections from the coach and interrupts the routine to listen to them;

(c) in the event of a mistake, the gymnast resumes the respective body/apparatus movements;

(d) the duration of a routine rehearsal has fallen from 3 minutes to 2.5 minutes in the precompetitive period, because, by refining the elements in each routine, the number of mistakes decreased, implicitly the repetition time.

The total volume of practice, spent during the entire eight weeks training programme is presented in Table 10.

Table 10. Total volume of effort

Training period	No. of repetitions/training period (no.)		Duration of routine rehearsal/training period (hours)	
	Without music	With music	Without music	With music
Preparatory - I st stage (*half routines)	384*	192*	9,6*	2,32*
Preparatory - II nd stage	144	96	7,2	2,32
Precompetitive I	76	24	3,4	0,58
Precompetitive II	112	36	4,8	0,87
TOTAL	384 ½ routines+ 332 complete routines	192 ½ routines+ 156 complete routines	9,6 for ½ routines + 15,3 for complete routines	2,32 for ½ routines + 3,77 for complete routines

Thus, from the processed data, it results that, during the eight weeks of training, the gymnast performed 384 half routines and 332 complete routines without musical accompaniment, amounting 9,6 hours for half routines and 15,3 hours for complete routines; 192 half routines and 156 complete routines with music, summing up a duration of 2,32 hours for half routines and 3,77 hours for complete routines.

Knowing the duration or routine rehearsal per training period, we also calculated the percentage of time assigned for these repetitions in the total training/period. The results are shown in Table 11.

Table 11. Percentage of time spent for the repetition of routines in the total time of training/period;

Training period	No. of training hours/period	Duration of routine rehearsal/training period (hours)		Percentage of time assigned for routine rehearsal in the total time of training/period (%)	
		Without music	With music	Without music	With music
Preparatory - I st stage (*half routines)	36	9,6*	2,32*	26,66	6,44
Preparatory - II nd stage	36	7,2	2,32	20,00	6,44
Precompetitive I	18	3,4	0,58	18,88	3,22
Precompetitive II	27	4,8	0,87	17,77	3,22

The volume of effort – distances reached within the routines

For this subchapter of the paper, there were realized, for each of the four routines of the gymnast, the layout and the sizing of the lines of elements/series of steps/apparatus movements that compose each routine, finally obtaining the distance that the gymnast reaches in each of the four routines. The results are shown in Figure no. 1, 2, 3, 4.

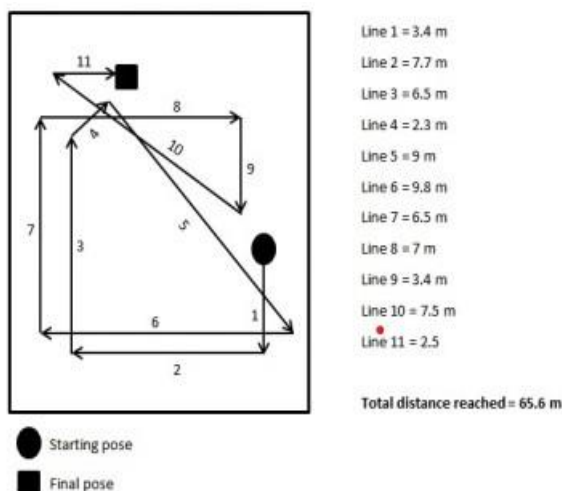


Figure 1. Distance reached during hoop routine

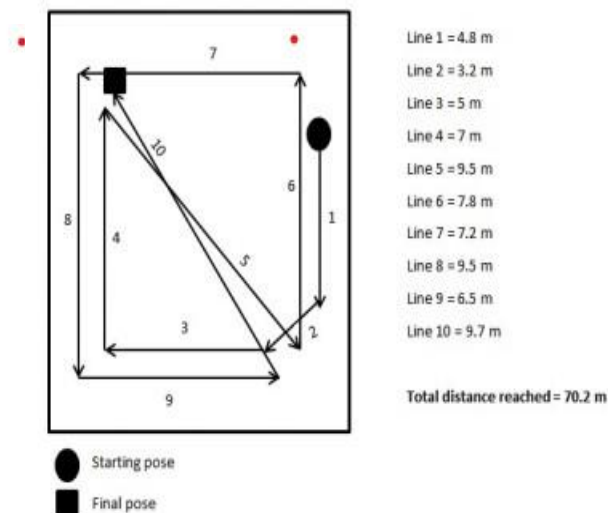


Figure 2. Distance reached during ball routine

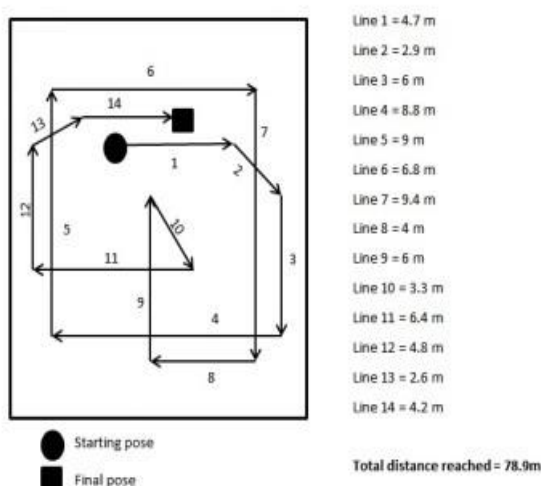


Figure 3. Distance reached during clubs routine

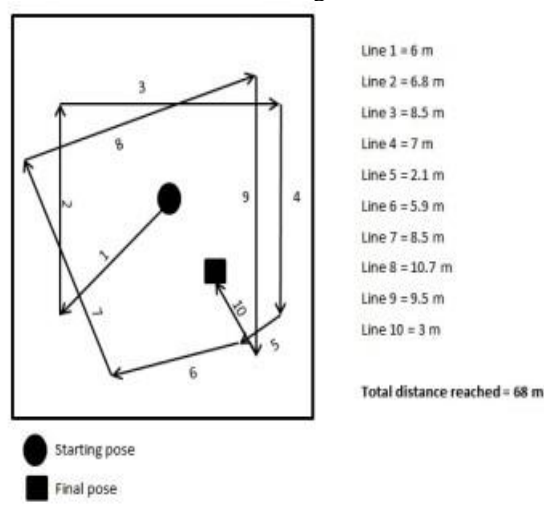


Figure 4. Distance reached during ribbon routine

Thus, from the data processed, there were calculated the distances covered by the subject of the research in each of the four competition routines, namely: hoop - 65.6 m, ball - 70.2 m, clubs - 78.9 m and ribbon - 68 m. Moreover, by processing the distance traveled by the gymnast in each training period, it was calculated, as well, the total distance reached throughout the entire training plan [Table 12].

Table 12. Distance (m) per routine/period/training plan

Period	Apparatus	Distance reached/routine (m)	No. of performed routines		Distance reached/period (m)	
			Without music	With music	Without music	With music
Preparatory I st stage Two weeks	Hoop	65.6	x48(*)	x24(**)	3148.8	1574.4
	Ball	70.2	x48(*)	x24(**)	3369.6	1684.8
	Clubs	78.9	x48(*)	x24(**)	3787.2	1893.6
	Ribbon	68	x48(*)	x24(**)	3264.0	1632.0



TOTAL (I st stage preparatory period)					13569.6	6784.8
Preparatory II nd stage Two weeks	Hoop	65.6	x48	x24	3148.8	1574.4
	Ball	70.2	x48	x24	3369.6	1684.8
	Clubs	78.9	x48	x24	3787.2	1893.6
	Ribbon	68	x48	x24	3264.0	1632.0
TOTAL (II nd stage preparatory period)					13569.6	6784.8
Precompetitive I One week	Hoop	65.6	x22	x7	1443.2	459.2
	Ball	70.2	x22	x7	1544.4	491.4
	Clubs	78.9	x16	x5	1262.4	394.5
	Ribbon	68	x16	x5	1088.0	340.0
TOTAL (I st precompetitive period)					5338	1685.1
Precompetitive II Two weeks	Hoop	65.6	x28	x9	1836.8	590.4
	Ball	70.2	x28	x9	1965.6	631.8
	Clubs	78.9	x28	x9	2209.2	710.1
	Ribbon	68	x28	x9	1904.0	612.0
TOTAL (II nd precompetitive period)					7915.6	2544.3
TOTAL (training plan)					40391.6	17799

(*) each half routine was performed 48 times, without musical accompaniment

(**) each half routine was performed 24 times, with musical accompaniment

It results that, during the eight weeks training, the subject reached a distance of 40391.6 m during routines performed without music and 17799 m during routines performed with music.

The intensity of effort - distance traveled during a specific time

Concerning the intensity of the effort, the distance reached in a routine / half of a routine was analyzed in relation to the duration of the routine. Thus, the results are presented in Table 13.

Table 13. The intensity of effort in terms of distance reached within a given time

Apparatus	Duration of effort (s)			Distance reached (m)			Intensity of effort (m/s)		
	Routine	I st half of the routine	II nd half of the routine	Routine	I st half of the routine	II nd half of the routine	Routine	I st half of the routine	II nd half of the routine
Hoop	87	43.5	43.5	65.6	33.9	31.7	0.75	0.77	0.72
Ball	86	43	43	70.2	33.3	36.9	0.81	0.77	0.85
Clubs	89	44.5	44.5	78.9	47.6	31.3	0.88	1.07	0.70
Ribbon	87	43	43	68	21.3	46.7	0.78	0.49	1.08

From the information presented in Table 13, some differences in the values of effort intensity can be observed between the first half of the exercise and the second half or between a routine with a certain apparatus in relation to another. These differences are justified by the need to diversify the competition routines, the styles that are approached, the series of steps, the dynamics of the movements and the pace of the chosen musical accompaniment.

The intensity of effort in terms of heart rate

For the present study, measurements of the heart rate of the selected gymnast were registered in key moments during the training session, respectively at the beginning of the training, before and after the warm-up, after the choreographic programme, after the rehearsal of routines performed with music, but also at the end of the training session, immediately after the physical training programme and 2 minutes after completing this training component [Table 14].

Table 14. The intensity of effort in terms of heart rate

Before warm- up	After warm- up	After choreographic programme	Apparatus routines			After physical training programme	Recovery (2 min after physical training programme)
			Apparatus	After one routine with music	After two routines with music (30 s rest between the two routines)		
			Hoop	155 bpm	169 bpm		
			Ball	149 bpm	164 bpm		
			Clubs	160 bpm	177 bpm		

80 bpm	116 bpm	124 bpm	Ribbon	153 bpm	165 bpm	136 bpm	91 bpm
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From the data recorded in Table no. 14, it can be noted that the highest intensity value is reached after the execution in series of two routines, with a rest of 30 seconds between them (177 bpm), a submaximal frequency, which differs from one routine with a certain apparatus to another, depending on its complexity and dynamics, and also depending on its duration, given that the highest heart rate values were found at the clubs routine, that has the longest duration of 89 seconds.

Knowing the heart rate values for each apparatus after the execution of one routine, and also after two routines, we calculated the average heart rate value (154,25 bpm after one routine and 168,75 bpm after two routines), therefore Figure no. 5 shows the evolution of heart rate value in a complete training, comprising all the training components. [Figure no. 5 near here]

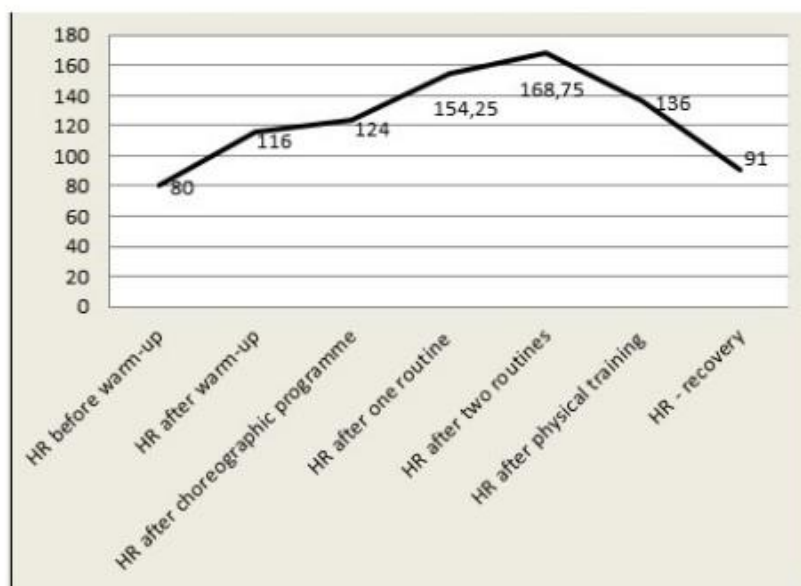


Figure 5. Heart rate frequency (bpm)

Discussions

In order to compare the results of our study with the findings of other authors on the same topics, we studied several studies. Thus, on what is concerning the number of training hours in other sports disciplines, a study on the training load for pre-pubertal subjects aged 7- 13 years showed that international level gymnasts trained an average of 26,42 hours/week, while national level gymnast trained 13,85 hours/week.

Comparing the distance traveled in a specific time in rhythmic gymnastics in relation to basketball, according to Bompa (2013), the total playing time in a basketball game is 26,3 minutes, while the longest playing period is 23 seconds. Regarding the distance traveled, according to the same author, a player runs 5-7 km/match, while his heart rate frequency is situated at 167 bpm and 25% of the match time exceeds 180 bpm.

In terms of heart rate frequency, we can compare our results with those of the study elaborated by Manos, Grigore & Popescu (2012) on the energy expenditure in rhythmic gymnastics, where, gymnasts aged 15-17, reached in a simulated competition, heart rate values situated between 180-186 bpm. The values are higher due to the fact that senior gymnasts have a higher difficulty of the elements included in their routines and they perform their exercise with a higher amplitude, therefore needing a lot more energy to spend. Also, the value of the heart rate was recorded in a simulated competition, when the gymnasts are much more aware of the importance of their execution, of the fact that they have to give their best, this aspect increasing the adrenaline and implicitly their heart rate.

Another study analyzing the heart rate belongs to Gateva (2014), who found, for gymnasts with an average age of 15.4, heart rate values between 187-200 bpm, recorded at the very end of the routine.



A research on the effort characteristic of junior male artistic gymnasts, conducted by Popa L. (2014) showed that during the floor exercises, which consists of acrobatic elements, combined with other movements of strength, balance and mobility and choreographic combinations, the heart rate of the gymnasts did not exceed about 150/160 bpm.

Conclusions

The effort in rhythmic gymnastics training, as in any other sports disciplines, varies depending on the training period: preparatory, precompetitive or competitive.

Performance in rhythmic gymnastics can only be reached through constant repetition of routines. A larger number of repetitions of the routines is essential for the gymnast to improve her performance and reduce the number of mistakes.

The distance traveled by the gymnast during the routine is another important indicator that emphasizes the volume of effort. It mostly differs depending on the series of steps and rhythm of the music.

The intensity of the effort in terms of distance traveled in a specific time varies from one routine to another, and also from one half of the routine to the second half, depending on its complexity, dynamics, series of steps, pace of musical accompaniment.

Regarding the HR values, the highest intensity value in our study was found after two routines executed in series, accompanied by music. Even if each apparatus routine was different in terms of complexity and dynamism, there were not significant differences in HR for the four apparatuses.

Depending on the results obtained in the competitions taking place during and after the training plan, it can be assessed whether the volume of effort set in the training plan has led to the gymnast's performance improvement, ranking on a position that fulfills the objectives. Otherwise, depending on the mistakes made by the gymnast, the coach will change the training plan to increase its efficiency for future competitions.

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