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THE EFFECTS OF EXERCISES USING PILATES APPARATUS ON HEART RATE

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Abstract

Cardiovascular assessment is a concrete way of measuring the effects of exercise on the body. Knowing how the cardiovascular system works during physical exercise provides objective data that allow establishing the desired intensity threshold. Pilates equipment presents variants of exercises corresponding to the construction of each apparatus. Depending on the working position and the load (resistance of springs and accessories), exercises have different intensity levels. In this paper, we aimed to investigate the evolution of heart rate in people practicing exercises on Pilates apparatus, by making a comparative analysis between the effects of programs performed on the Reformer, Cadillac, EXO Chair and Bodhi Suspension System. We wanted to see whether the level of demands would be differentiated, and if so, to what extent. The method used is the case study. There were investigated 5 subjects practicing Pilates exercises at the Shape Art Pilates Studio, with a frequency of 3 lessons per week. In each lesson, a framework program was executed on one of the above-mentioned machines. To assess heart rate, it was used the Garmin Vivoactive Watch, together with the sensor chest belt. This device receives real-time information via Bluetooth from the chest belt, memorizes heart rate and provides a graph with the time, average heart rate and maximum heart rate. The results showed both the level of cardiovascular demand and the intensity-related features provided by each Pilates apparatus. The obtained data can be used to manage the effort and individualize programs according to each subject's particularities.

Keywords: Pilates apparatus, effort, demand, heart rate.

1. Introduction

Practicing various motor activities is one of the conditions for maintaining a healthy body. Regular physical exercise leads to morphological and functional improvements with a prophylactic role, which results in increasing our capacity for physical effort and preventing the emergence of certain illnesses (European Commission, 2008).

Exercise also contributes to achieving the interaction between homeostatic adaptive reactions of the internal environment and those from the external environment (Dragnea & Bota, 1999, p. 184). Besides its functional benefits, regular exercise improves physical appearance and body awareness, and can induce "positive addiction", which highlights a healthy lifestyle (Bota, 2006, p. 158).

Practicing motor activities in an organized environment involves proper management of the effort, which should lead to the development or maintenance of motor and exercise capacity; and this because physical exercise mobilises all adaptive mechanisms of the body, the levels of demand directly depending on the nature, duration, intensity and complexity of the stimulus.

2. Problem Statement

One of the first systems that intervene to support the effort is the cardiovascular system by increasing heart rate (HR), which leads to an increase in cardiac output (Jurcău, Jurcău, & Bodescu, 2012). It results an increased blood volume and flow in the exerted muscles. During exercise, the muscle and joint systems, as well as the baro-processors and chemo-processors in blood vessels, send impulses that control the activity of the cardiovascular system (Anghel & Relu, 2006).

Permanent adaptation is based on both the direct influences coming from the tissues and the activity of indirect neuroendocrine mechanisms (Popescu & Predescu, 2009, p. 21). The involvement of the vascular system in supporting the effort motivates the need to monitor HR; and this because HR is an objective indicator that provides data about the echo of exercise on the body and the possibility of intervention to establish the exercise parameters (Şalgău & Mârza, 2007, p. 257).

Knowing the heart's reaction to effort represents a real guide to achieve the goals of an exercise program, ensuring its objectification and individualisation according to the particularities of each participant (Benson & Connolly, 2011, pp. 3-4).

Pilates method is an exercise system that provides a good relationship in the functioning of cardiovascular and respiratory systems, due to breath control. The benefits of this interaction are found in the ways of developing the two systems, which leads improving fitness (Pilates & Miller, 2010, p. 22).

Within the programs using Pilates equipment, the effort is predominantly aerobic in nature, exercises being performed slowly, with a high level of control over movement, posture, working position and breathing.

Pilates machines have been designed to provide a wide range of exercises that can be executed separately, by segment, or can engage large muscle groups and chains. Exercises can be adapted to any level of training and motor experience and are intended for people suffering from various neuromotor dysfunctions (St. John, 2006, p. 6).

3. Research Questions

Do exercises on various Pilates machines cause differentiated reactions to heart rate?

4. Purpose of the Study

The purpose of the paper is to see how a framework program performed on various Pilates machines can influence the HR evolution in adult people with an advanced level in the practice of this motor activity. We have started from the premise that Pilates machines are of several types, have various accessories and can be used from different positions: lying, sitting or standing. Depending on the working positions and the level of loading the accessories, the demand on heart is supposed to show differences and variations.

5. Research Methods

The research used the case study method. The subjects were 5 adult people practicing exercises, at an advanced training level, on Pilates apparatus at the SHAPE ART PILATES Studio.

As demographic data, the subjects were adult people, 3 females (no. 1, 2, 3) and 2 males (no. 4, 5) aged between 25 and 32 years, except for subject 1, who was in the age group over 60 years. All subjects, former performance athletes, gave their consent to participate in the research.

Subject selection was based on the fact that they knew the apparatus and types of exercises used, and were able to control well their movements and properly coordinate them with breathing. The subjects executed, in four distinct lessons, a program on each of the following machines: Reformer, Cadillac, EXO Chair and Bodhi Suspension System, which are presented in figures 01, 02, 03 and 04.

Figure 01. Reformer presentation

Reformer (figure 01.) is a bed fitted with a carriage sliding on a roller system, which is attached at one end to a set of springs differentiated as resistance. In terms of accessories, it is also equipped with a system of strings that can be used at the level of upper or lower limbs. Working positions: lying, sitting, kneeling, standing, each with different variants.

Figure 02. Cadillac presentation

Cadillac (figure 02.) is also a bed framed, like a parallelepiped, by 4 vertical bars and 5 horizontal bars. Accessories: fixed or mobile adjustable bars, a set of 10 springs attached to the bars, karabiner straps. Working positions: lying, sitting, kneeling, standing, each with different variants.

Figure 03. EXO Chair presentation

EXO Chair is a chair without backrest, equipped with 2 foot pedals, 2 spring platforms and elastic bands. Working positions: sitting, kneeling, standing, each with different variants

Figure 04. Bodhi Suspension System presentation

Bodhi Suspension System is a system of 4 suspended ropes bonded two by two, equipped with handholds and foot straps. Working positions: lying, sitting, kneeling, standing, hanging, each with different variants

HR assessment was done using the Garmin Vivoactive Watch, together with the sensor chest belt. The device receives real-time information via Bluetooth from the chest belt, memorises heart rate and provides a graph with the time, average heart rate and maximum heart rate.

On each of the mentioned machines, it was performed a framework program with an average duration of 30 minutes, containing 10 types of exercises with 5 variants each. HR testing was done only

during the 30 minutes of actual work on the machine, was preceded by 10 minutes of warm-up and was followed by 10 minutes of dynamic and static stretching, and also breathing exercises.

Exercises were similar, so that the assessment and highlighting of the differences could reveal the type of demand imposed by each apparatus. The programs aimed at muscle toning under intersegmental coordination conditions. There were used alternations of concentric and eccentric contractions against the resistance imposed by the accessories specific to each apparatus. The subjects performed exercises at a slow and controlled pace, and also at their own pace of execution.

6. Findings

Table 01. shows the HR values achieved by each subject on each of the machines used. From the analysis of the graphs made by the Garmin Vivoactive Watch, we took into account, as physiological indicators, initial HR (recorded at the beginning of the program), as well as average and maximum HR.

Table 01. Heart rate values

Subject	Reformer			Cadillac			EXO Chair			Bodhi Suspension System		
	Min	Avg.	Max	Min	Avg.	Max	Min	Avg.	Max	Min	Avg.	Max
Subject 1	100	**128**	*163*	82	**112**	*140*	90	**121**	*146*	91	**130**	*157*
Subject 2	76	**96**	*120*	63	**97**	*128*	84	**114**	*135*	74	**115**	*151*
Subject 3	64	**109**	*144*	70	**100**	*119*	95	**120**	*151*	67	**108**	*140*
Subject 4	88	**108**	*126*	80	**97**	*118*	76	**112**	*135*	75	**114**	*153*
Subject 5	88	**117**	*149*	64	**100**	*137*	67	**123**	*151*	82	**112**	*140*

Analysing the evolution of subject 1 (figure 05.), we find that higher demands have occurred in the Reformer program, averaging 128 bpm, with a maximum of 163 bpm, and similarly in the Bodhi Suspension System, averaging 130 bpm, with a maximum of 157 bpm. Relative to the age of the subject, the level of demand ranges, as average intensity, between 75 and 85%. The programs performed on Cadillac and Exo Chair highlight similar demands, although the HR values are slightly lower. The subject copes with the program, and the intensity level allows the maintenance of physical fitness.

| Reformer | Cadillac | EXO Chair | Bodhi Suspension |
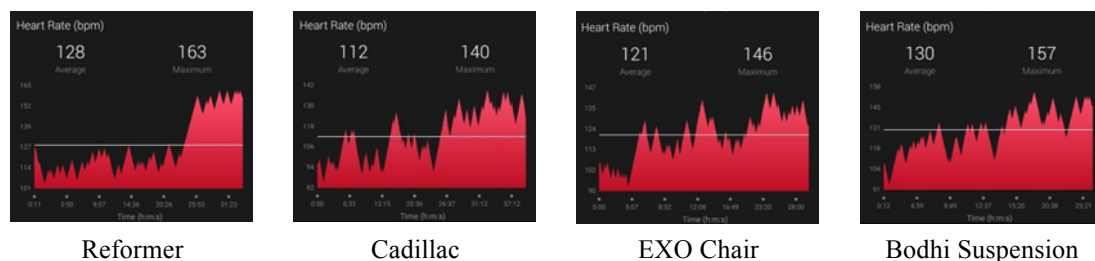
Figure 05. Graphical representation of HR evolution for the subject 1

For subject 2 (figure 06) the highest demand was recorded on the Bodhi Suspension System (an average of 115 bpm), followed by Exo Chair (an average of 114 bpm).

144

| Reformer | Cadillac | EXO Chair | Boghi Suspention |
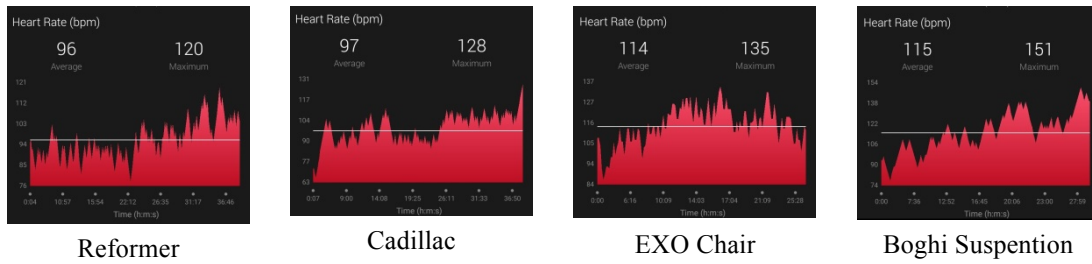
Figure 06. Graphical representation of HR evolution for the subject 2

The program performed on Exo Chair also represented for subjects 3 (figure 07) and 5 (an average of 120 bpm and 123 bpm, respectively) the highest demand, compared to other machines.

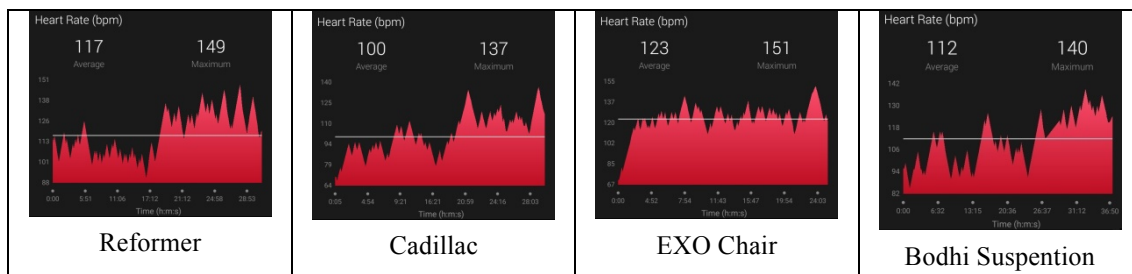| Reformer | Cadillac | EXO Chair | Bodhi Suspention |
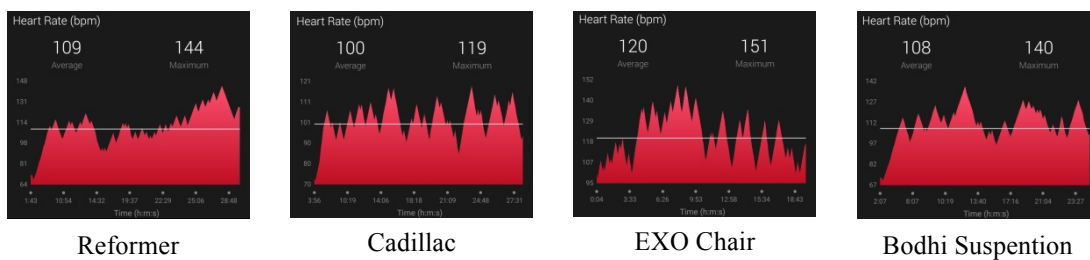
Figure 07. Graphical representation of HR evolution for the subject 3

Analysis of HR evolution for the female subjects 2 and 3 and the male subjects 4 (figure 08.) and 5 (figure 09) , relative to their age, generally emphasises an intensity level between 50 and 60%, which means a low to medium demand.

| Reformer | Cadillac | EXO Chair | Bodhi Suspention |
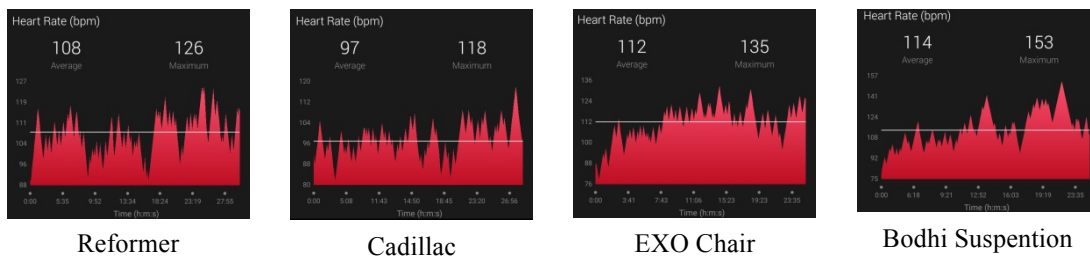
Figure 08. Graphical representation of HR evolution for the subject 4

| Reformer | Cadillac | EXO Chair | Bodhi Suspention |

Figure 09. Graphical representation of HR evolution for the subject 5

The graphical representation provided by the Garmin Vivoactive Watch is shown in figures 05, 06, 07, 08 and 09. We mention that, for each apparatus, the program started with exercises from lying positions, followed by exercises from sitting, kneeling and then standing variants. The lying positions were not used on Exo Chair, the only machine that does not allow them.

The graph analysis shows the particularities of HR evolution for each subject and performed exercise. The impact of each exercise group can determine the individualisation of training programs in the future.

From our study, we find out that, in the programs using Pilates equipment, the effort is aerobic, the level of demands identified in the 4 subjects ranging between 50 and 60% on average. According to the literature data, we found that the cardio training zone had low intensity (Cordun, 2011, p. 182). We think that exercise intensity can be improved by imposing differentiated working paces, which raise the average HR to a higher effort zone.

A comparative analysis of the machines puts on the first place, as level of demand, the Bodhi Suspension System, followed by Exo Chair, Reformer and Cadillac. In our opinion, this hierarchy is beneficial for the individualisation of programs and their adjustment to the training level of each participant. Thus, we recommend the beginners to use first the Cadillac and Reformer programs. Bodhi Suspension System is recommended for advanced levels.

HR monitoring helps to better direct the effort zones proposed to the participants, and in conjunction with breathing, as a basic principle of Pilates practice, it ensures the blood flow necessary to execute the programs (Puelo & Milroy, 2016, p. 24).

7. Conclusion

Heart rate investigation through the framework programs performed on the four Pilates machines has captured the differentiated demands of each apparatus.

The case study gave us the opportunity to see in what effort zone each subject had worked. We believe that, for younger ages, exercises can be performed at the differentiated paces imposed by the instructor, so as to lead the training toward a higher cardiac zone. The most demanding machines, with reference to the cardiac effort zone, were the Bodhi Suspension System and Exo Chair.

Finally, we think that exercises on Pilates machines cause differentiated reactions to heart rate.

Acknowledgments

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