ANALYSIS OF HEART RATE IN DIFFERENT TYPES OF CLASSES OF PHYSICAL EDUCATION

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Abstract

*Several studies claim that the physical effort of students during Physical Education classes (PE) is low. There is a lack of desire to change or improve physical fitness levels. **Purpose:** In this study, we intend to analyse the average values of heart rate (HR) during different phases of the PE class, trying to identify possible differences between collective and individual sports (basketball and apparatus gymnastics). The sample consisted of a group of 15 students, 5 female and 10 male (15.2 ± 12:56 years) and the study was conducted over 10 sessions (5 of each type), registering values of HR (bpm) using HR monitors (Polar Electronic, FT1 model). **Results:** After exploratory data analysis there were significant differences in the transition phase (basketball: 146 ± 27.2 bpm, p = 0.001; apparatus gymnastics: 138.4 ± 25.8 bpm, p = 0.001) and the drilling stage (basketball: 151.2 ± 26.1 bpm, p = 0.000; gymnastics apparatus: 143.0 ± 27.0 bpm, p = 0.000). In the process of organizing, the differences were not significant (basketball: 136.8 ± 26.2 bpm, p = 0526; apparatus gymnastics: 132.3 ± 23.9 bpm, p = 0526). **Conclusions:** Having these results, we believe that PE teachers should plan sessions that provide increased uptime and higher levels of intensity for students, especially in periods of drilling, regardless of the class.*

Key words: *Physical Education, Heart Rate, Intensity, Basketball, Gymnastics*

Introduction

We have witnessed a worrying increase in sedentary lifestyles worldwide. In Portugal, according to the European Commission's Web Site [17], only 8% of the population surveyed, between 15 and 55 years old, play sports regularly, and 64% never practiced any sport. The number of people without a regular habit of engagement in sports is high, whether in schools, in their own free time, at weekends or even during classes of Physical Education (PE). According to a study held in Portugal in 2007 of 319 teenagers 33.5% are inactive and 22% are either overweight or obese [8].

The school is undoubtedly a place with an environment that provides several opportunities and activities for children to be active whether through PE classes, Sports in School, or simply playing and informal games in school breaks. The school and teachers should be performing daily physical activities with their students, conveying the importance of regular practice, either for children's health, or to increase the level of motor development, and encouraging a healthy life style [18]. Indeed, the PE classes should contribute approximately to the level of recommended exercise for young people: currently 60 minutes a day of aerobic and endurance activities, from moderate to vigorous intensity, including activities that involve the skeletal-muscle system three or more times a week [11, 14]. PE lessons, in addition to contributing to the levels recommended above, should promote the development of the student, their socialization, healthy living, team spirit, their relaxation and sports should also be exciting and motivating.

PE programs are directed towards physical activity for health, but these must have a better control of the physical exercise that students are subjected to in classes, to achieve a significant influence on learning healthy habits by practicing these ones [9].

Several studies on young people [1, 6, 9, 10, 13, 18, 21], describe in fact the level of physical effort in PE classes and the respective heart rate (HR) responses in relation to the intensity of exercises performed in class. In a general context, these authors report that during PE classes young people spend very little class time performing moderate to vigorous physical activity, and spend too much time in organization, changing clothes and hygiene tasks [9, 13, 18, 21].

Regarding the different types of activities in PE classes, Sarradel et al. [18] states that activity and intensity can vary depending on the content. So, activities such as team games and tennis, require longer periods of moderate to vigorous physical activity (50% -80% maximum heart rate) in both sexes, compared to activities like fitness and dancing. While Wang, Pereira & Mota [21] report that the activities in which students reach higher HR values are their favourite programs such as football and volleyball and that they are considered less active in gymnastic classes. Also related to this variable, Gao, Hannon & Carson [6] assume that in dancing, students remain at a significantly lower HR when compared to activities such as "catch ball" football and walking/running.

In the literature researched, we found studies analysing the HR comparing a collective sport with an individual sport, considering the different stages that make up a 90 minutes class, and the different behaviours that these induce in students.

This study was conducted with the objective of contributing to a better understanding in this field, trying to analyse the differences between sports (basketball and apparatus gymnastics) concerning the intensity of physical activities proposed in PE classes. We have reference to the HR records among the PE classes of two different types (collective and individual sport).

Methods

Sample

The sample consisted of 15 students (10 male and 5 female) aged between 15 and 17 years (15.2 ± 0:56 years), belonging to a 10th grade class of a school in the interior region of Portugal, located in an urban centre of that district.

The sample was selected for the researchers' convenience, and it is a class with a high level of attendance and punctuality. It is also homogeneous in terms of age and was identified by school teachers as very committed and motivated during PE practice.

The following sample exclusion criteria were considered: students with special educational needs; practice of sport or physical activity outside the school; students with injuries and medical limitations, as well as students from classes with 3 sessions of 45 minutes per week.

To ensure ethical clearance, we requested authorization from the school board and asked a teacher to cooperate with the study as an advisor so that the research could be performed. In addition to this, information was provided to parents regarding the study procedures, along with a request for the necessary signed informed consent authorizing the participation of their children in this study. For the implementation of the research, students were warned about the type of study that would be conducted and that classes would take place normally, so their behaviour should not be different from usual.

The study was conducted over 10 random PE classes, comparing five classes of gymnastics apparatus with 5 classes of basketball.

During each lesson of the study, HR measurements were recorded, and controlled depending on the type of activity that the students had to perform. These phases were adapted from Guedes and Guedes [10] and divided into three categories, according to the activity, to understand where there would be more discrepancies in students' HR:

Phase 1 - Organization of classes: situations where students receive a teacher's

instructions regarding the provision, organization and implementation of activities to be performed;

Phase 2 – Activities Transition: situations where students are waiting to participate in the next activity or transition period thereof;

Phase 3 – Drilling (exercise): situations in which students must participate in activities proposed for Basketball: Situations in which students must participate in the activities proposed for gymnastics apparatus.

HR is considered one of the main physiological variables when referring to the exercise prescription and becomes a key tool in knowing the response of students in different exercise situations, showing at which stages students had higher intensity [2]. For HR records we used a HR monitor (Polar Electronic, FT1 model) fixed on student's chests, which recorded during the class time, as in the study by Guedes and Guedes [10].

In gymnastic apparatus class three measurements of HR were recorded in phase 1, two in phase 2 and five in phase 3. In the basketball classes two measurements were registered in phase 1, three in phase 2 and three in phase 3. Each record was taken every 6 minutes calculating an average value corresponding to the number of measurements taken.

Statistical analysis

The collected data were extracted to Excel, and later to the SPSS software (version 21.0 for Windows), where all the statistical analysis was performed.

Because of exploratory data analysis outliers were eliminated, as well as cases in which an item had no registration. The phase that corresponded to the students' FC when they arrived at the lesson was also eliminated (considered as phase t0), since there was a large discrepancy between the students' levels at the beginning of the class, compared to levels from previous activities and the initial levels and those taken during the class.

We analysed mean, standard deviation, minimum and maximum values. For comparison of the mean values (HR in basketball exercise classes and gymnastic apparatus classes) we used the t-test for paired samples to infer the equality of means between the two types of classes and comparable phases. The established statistical significance criterion was predetermined by $p < 0.05$.

Results

Table 1 shows the HR means results, the standard deviation and sig-nificance level of the three phases defined: organization (T1), transition (T2) and drilling (T3).

Table 1. HR values depending on the class phase (Mean ± standard deviation).

Phase	Sport	HR mean ± standard deviation (Minimum - maximum)	P-value
T1	Gymnastics Apparatus (n = 15)	132.3 ± 23.9 (85-191)	0.526
	Basketball (n = 15)	136.8 ± 26.6 (79-190)	
T2	Gymnastics Apparatus (n = 15)	138.4 ± 25.8 (91-187)	0.001
	Basketball (n = 15)	146 ± 27.2 (80-198)	
T3	Gymnastics Apparatus (n = 15)	143 ± 27 (87-199)	0.000
	Basketball (n = 15)	151.2 ± 26.1 (87-202)	

It is observable that when comparing the HR mean values of each sport and class phases we found that HR results in basketball are always higher (in mean values) than gymnastics apparatus values in each phase. Also, in basketball we have higher maximum HR values than in gymnastics apparatus, during the time of transition and drilling, and gymnastics apparatus registered a higher maximum HR, in time organization. Regarding the minimum HR values, it was found that basketball was the activity that registered the lowest minimum value, and during

the time of organization and drilling there were values of a minimum HR identical for both sports. The data also revealed the existence of significant differences (p = 0.05) between the two sports at the transition and drilling phases, with basketball achieving higher averages. In the organization phase there were no significant differences between the two types of classes (p=0526).

Discussion and conclusions

The purpose of this study was to establish whether there are dif-ferences of HR in collective and individual sports during PE classes. The data revealed the existence of significant differences in intensity, collected by HR measurements, between the two types of classes / sports that we studied in the transition and drilling phases.

The school should be a privileged place to promote physical activity in young people and, given the frightening prevalence of obesity that currently exists, and bad lifestyle habits that contribute to this situation, the role of the school as a promoter of physical activity is determinant.

In this study we compared effort intensity by HR measurements over five random PE classes in basketball and gymnastics apparatus. For this, we analysed and separately compared the different phases of these classes. The results demonstrate that mean values of HR achieved in team sports classes are higher than in individual sports, with significant differences in transition and drilling phases.

For this study HR recorders were used, allowing us to quickly and efficiently register the heartbeats. The student sample was carefully selected because it is a homogeneous group regarding physical activity, and not one which practiced sports in an extracurricular form. As already mentioned, the kinetics of frequency throughout the different classes was defined in three main phases – adapted from Guedes & Guedes [10] – expecting lower values of HR in phases of organization and transition, and higher in the drilling phase.

The results of this study indicate that students maintain an average level of physical activity above 60% of their maximum heart rate,

given the simplified calculation (HRmax = 220-age) proposed by Karvonen, Kentala and Mustala [12] and widely applied in different studies. Thus, student's HR assumes values of physical activity from moderate to vigorous, considering the existing literature [6] for moderate to vigorous physical activity (60 to 90% of maximum heart rate).

According to Thompson, Gordon and Pescatello [20], The HR values obtained in the organization phases of gymnastic apparatus and basketball (132 bpm and 136.8, respectively) can be described as low to moderate exercise, so it could be considered a sufficient incentive to improve the base resistance. The same is observable in periods of transition of the gymnastics apparatus classes.

The values observed in periods of transition in basketball classes exceed 70% of the maximum heart rate of students, and therefore correspond to values of moderate to vigorous, according to Gao, Hannon and Carson [6].

The drilling phase has shown major differences, verifying values corresponding to a moderate to low effort in gymnastics apparatus classes compared to basketball, where HR was found with values close to 75% of FC maximum predicted. There was therefore the occurrence of vigorous exercise values in all of the types of classes, although, in basketball, HR values were higher than the gymnastics apparatus. These data are like the results reported by Guedes and Guedes [10], in which students have HR means in the classes observed between 132 and 147 bpm.

We assume, as referred in their studies Guedes and Guedes [9, 10], Wang, and Pereira Mota [21], Gao, Hannon and Carson [6], Sarradel et al., [6], Kremer, and Reichert Hallal [13] the values of HR mean are far lower than what should be desirable, and happened given the short time that students were in moderate to vigorous physical activity. However that in-sufficient time is conditioned also by the fact that class time has been reduced, since the students lost about 25 minutes of class time during the period referred to as Discipline Regulations for changing and hygiene. The recorded HR values also appear due to the existence of too many

drills transitions due to the high number in the program content that exists in schools. This factor does not allow for ongoing drilling and consequently the expected increase in HR. Thus, the lowest percentage of maximum FC achieved may be due to pauses between exercises. In fact, some au-thors describe the national programs as overloaded; Gonçalves and Car-valho [7] have reported that teachers tend to classify the allotted time to meet the programs as "rudimentary", "short", "almost impossible to work," "almost always the same," "does not have a very favourable opinion". Despite the school being studied having adapted the program, this problem persists.

Our study also noted that in basketball classes students maintain HR values significantly higher than in the gymnastics apparatus classes when they are in transition phases and drilling. According to the organization phase, the differences were not significant. In our opinion these results happen because in basketball lessons exercises are more intense and dynamic and the students present a higher commitment to this tasks, which makes the transition time between exercises insufficient for there to be a greater decrease in HR values. Regarding the organizational phase, the significance of the compared results is less, because, while basketball students rest in this phase, students in gymnastic apparatus classes help with the transportation of the devices, which automatically increases HR and thereby brings both sports to similar HR values.

One of the most relevant limitations of this study was the unavailability of registering HR values automatically and with shorter time intervals. This would require using HR monitors with a possibility of automatic HR records to avoid pauses in class to measure HR, as reported in previous studies [6, 10, 21]. As a proposal for studies in this context, we suggest that in the future the sample and the number of analysed classes could be increased, seeking greater rules regarding diversification. Additionally, we also suggest that the classes can be filmed to improve the reliability of recording time of each student throughout the different phases of the defined classes, also maintaining the direct observation instrument as used in the study of Guedes and Guedes [10], checking the type of activities that students are doing.

This study allows us to conclude that there are significant differences between classes of team sports and individual sports, with significant differences in the drilling phase and transition. In these phases the students are always active, with HR levels that correspond to an important stimulus for the development of aerobic capacity (except for the transition phase in the apparatus gymnastics). As the HR values were recorded over 10 classes, the representativeness of the same in the trimester is relevant (representing about 43.5% of all lessons), so it is pertinent to highlight that teachers should pay special attention to these phases in classes to succeed in keeping students active.

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