No. 1, Vol. XIII /2012

G Y M N A S I U M

Scientific Journal of Education, Sports, and Health

INTENSITY DIFFERENCES OF INTERVAL TRAINING BETWEEN AEROBICS AND SPINNING

Gordana Furjan-Mandić[1]*,
Martina Zovko[2],
Ana Pavić[3],
Milan Žvan[4],
Miran Kondrič[5]

[1,2] *University of Zagreb, Faculty of Kinesiology, Horvaćanski zavoj 15, 1000 Zagreb, Croatia*
[3] *University of Split, Faculty of Kinesiology, Teslina 6, 21000 Split, Croatia*
[4,5] *University of Ljubljana, Faculty of Sport, Gortanova 22, 1000 Ljubljana, Slovenia*

Keywords: *interval training, aerobics, cycling, intensity*

Abstract

The purpose of this survey was to identify any possible differences in average heart rate for two different groups of subjects undergoing interval training either in aerobics or in spinning, and to find out which of the two programmes has the highest impact on cardiovascular system. The participants were 70 women (aerobics group – age 29.37 [SD=3.42]; spinning group – age 29.49 [SD=3.63]).

Descriptive statistics of variables was presented and the differences between the two groups were analysed using the *t*-test. The results showed the difference in average heart rate after the principal part of the workout and in the percentage of maximal heart rate taking into account the age of the participants.

According to different levels of fitness, the results showed that the programmes of interval training in spinning and interval training in aerobics developed both in anaerobic conditions (improvement of blood flow, favourable for increasing speed endurance, the level of lactate tolerance and anaerobic threshold and increasing the muscle tonus).

1 Introduction

Cardiovascular system is one of the basic parts of the oxygen transport system which, through its adaptation capacity, provides increased energy and homeostatic requirements during and after physical effort. There are many indicators that point to the state and functioning of the cardiovascular system, and one of the parameters that are easy to measure is the heart rate (HR), i.e. the number of cardiac cycles in a minute.

The transformational programme in female adults requires that the intensity of exercise be accurately determined and that kinesiological stimuli by appropriately selected based on the initial status of subjects.

* *E-mail*: miran.kondric@fsp.uni-lj.si

Many authors have analysed the physiological reactions to aerobic exercise. Thomsen and Ballor (1991) pointed to the increased need for oxygen consumption in less experienced subjects. Williford et al. (1989) found that the average calorie consumption during aerobics classes amounted to 4-5 kcal/min on average. Scharf-Olson et al. (1992) connected the heart rate values with those of maximal oxygen uptake in aerobics programme gymnasts. Bell and Besey (1996) concluded that palpation is not a reliable method for measuring the heart rate for the purpose of determining the load as a measure of intensity in the subjects. However, it is to be considered a reliable indicator as a general measure of load.

It has been proven that physical activity causes changes in cardiac cycles, i.e. physical exercises increases the heart rate. It is the heart rate that points to the intensity of a workout, and primarily whether the workout was in compliance with one's cardiovascular capacity and expectations. Upon the arrival to a fitness centre people should set the goals that they want to achieve by participating in physical exercise programmes. These goals usually address the reduction of body fat, the regulation of body weight and the increase of muscle tonus. The workout that is done in aerobic zone should be selected to achieve these goals.

Interval training in aerobics is an aerobic programme based on all movements in aerobics (low and high impact) with changes in aerobic part lasting two minutes and high intensity strength exercises lasting four minutes. Strength exercises can be executed in standing, kneeling, sitting and lying position and various requisites can be used, e.g. weights (1.5 kg, 2 kg, 3 kg), long and short rubber bands, big and small balls, barbells, (step) benches (Metikoš et al., 1997).

Interval training in spinning is a unique group activity which imposes no load on the joints and which is done indoors, e.g. in aerobics gymnasia, on specially designed bicycles. This type of training includes low-volume but high-intensity exercises (Fried, 1997).

Interval training in spinning can be divided into three groups:

1. one to three minutes' duration and the rest amounts to 100% of the interval
2. three to five minutes' duration and the rest amounts to 75% of the interval
3. more than five minutes' duration and the rest amount to 50% of the interval.

All three types are extremely strenuous and difficult to execute because they are completely anaerobic which implies that lactic acid is produced consequently producing the feeling of burning and pain in the muscles.

The aim of this research was to identify any possible differences in average heart rate for the female subjects groups participating either in aerobics or spinning interval training, and to find out which of the two programmes has a higher impact on cardiovascular system.

2 Materials and methods

2.1 Sample

The research was done on a sample consisting of 70 female subjects (aerobics group – age 29.37 [SD=3.42]; spinning group – age 29.49 [SD=3.63]) participating in one of the two interval training programmes, aerobics (n=35) or spinning (n=35), in the fitness centre 'Vita'.

2.2 Variables

The variables used in this analysis addressed the morphological status of subjects (body height, body weight), maximal heart rate (calculated according to Karvonen's formula) and those addressing heart rate after the total of six parts of a workout (HR after warm-up, HR after each 4 minutes and HR after each 2 minutes *(in the principal part of the workout)*; HR after stretching; HR at the end of the workout). Each part represented six intervals lasting 4 minutes and six intervals lasting two minutes. The subjects filled in the questionnaire containing questions regarding demographic data.

2.3. Methods of data analysis

Statistical data analysis was done by using the statistical package *Statistica for Windows*, version 8.0. The descriptive analysis of variables included the calculation of arithmetic means, standard deviations, minimum and maximum values, range of results, and skewness and kurtosis coefficients. The normality of distribution was tested by Kolmogorov-Smirnov test. The descriptive statistics and the Kolmogorov-Smirnov test were calculated separately for the subjects participating in the aerobics and those participating in the spinning workout. The statistical significance of differences in heart rates between the subjects exercising in two interval training groups was tested by using *t*-test for independent samples. All results were significant at the level of $p<.05$.

3 Results and discussions

The characteristics of subjects in each of the two groups are presented in Tables 1 and 2.

Table 1 *Descriptive parameters of general characteristics of subjects participating in spinning workout*

	$\bar{x}$	s	min	Max	max D
AGE	29.49	3.63	25	36	0.15
BH	169.80	6.01	157	181	0.13
BW	64.91	9.39	51	90	0.14
HRR	71.91	7.68	58	84	0.10

Legend: AGE – age; BH – body height; BW – body weight; HRR – hearth rate at rest

Table 2 *Descriptive parameters of general characteristics of subjects participating in aerobics workout*

	$\bar{x}$	s	min	Max	max D
AGE	29.37	3.42	25	36	0.14
BH	169.31	6.28	158	181	0.10
BW	63.00	8.91	48	80	0.15
HRR	72.40	7.32	58	85	0.15

Legend: AGE – age; BH – body height; BW – body weight; HRR – hearth rate at rest

Tables 1 and 2 displays the characteristics of the sample by groups, i.e. the number of subjects in each of the two programmes – arithmetic means of basic morphological characteristics, the average age of the subjects as well as the heart rate at rest.

The subjects participating in the research started to take part in the programme in September 2010, and the final research was done at the end of February 2011. This time period sufficed for the subjects to master the technique of execution of exercises in each of the two programmes and to develop the basic neuromuscular adaptations which appear after eight to twelve weeks from the commencement of regular physical activity participation.

Table 3 *Descriptive parameters of heart rate in subjects participating in spinning*

HR	$\bar{x}$	s	min	max	max D
AWU	140.86	6.71	131	158	0.15
1-4min	150.17	5.15	141	163	0.12
1-2min	171.06	5.68	160	183	0.09
2-4min	154.11	8.62	138	170	0.16
2-2min	171.43	6.02	155	183	0.15
3-4min	151.63	8.30	138	169	0.10
3-2min	169.46	6.84	157	183	0.10
4-4min	153.06	7.80	137	171	0.12
4-2min	171.37	6.45	160	184	0.16
5-4min	152.69	10.05	135	171	0.14
5-2min	172.26	5.84	160	182	0.14
6-4min	152.63	9.97	133	172	0.11
6-2min	171.14	7.43	158	184	0.13
STCH	122.34	8.01	109	149	0.11
AWO	104.74	9.34	89	125	0.12

Legend: AWU – after warm-up; STCH – stretching; AWO – after workout

Table 3 shows the average heart rates in the subjects participating in the spinning workout for all fifteen variables. The lowest homogeneity of results (s=10.05) is evident for the variable of the fifth interval, which lasts four minutes (5-4 min), and the highest homogeneity (s=5.15) of results is displayed for the variable of the first interval lasting 4 minutes (1-4 min). Such a high value in the test of the fifth interval in four minutes (5-4 min) was probably due to the exhaustion of subjects and the concentration decrease occurring at the end of a workout. This consequently means that those subjects who have not exercised during the years or who have not worked out on a regular basis will find it more difficult to complete the final part of the workout.

The confirmation of this finding is also the high value of standard deviation of the sixth interval, which lasts four minutes (6-4 min) and where fatigue experienced by the subjects in the final part of the workout is evident. The test of the first interval during four minutes showed the highest homogeneity of results. The reason is the beginning of the workout as well as being rested and motivated for the workout. Subsequently it is necessary to adapt the intensity since the subjects in question are people who participate in physical exercise on recreational basis.

The values of standard deviations make it possible to conclude that the groups tested were not homogeneous, i.e. the subjects differed by the level of their physical fitness which was partly indicated by their heart rates. This is also evident in the range results. The range was the widest (as much as 40) in the variable *stretching (STCH)*, whereas the subjects differed the least in the variable *after warm-up (AWU)*, the range being 27, which was also found in some other researches (Anderson, 2011).

The differences in the level of physical fitness are still evident and the main indicator is the recovery level. Body weight (BW) and heart rate at rest (HRR) affected the high variability of heart rate values, this variability being displayed in Tables 3 and 4.

Such a high variability of results could probably be attributed to the physical fitness level, body weight and partially to the subjects' age.

Table 4 *Descriptive parameters of heart rate in subjects participating in aerobics*

HR	$\bar{x}$	s	min	max	max D
AWU	145.94	11.04	124	162	0.14
1-4min	137.69	9.58	120	159	0.08
1-2min	154.74	10.36	140	172	0.12
2-4min	140.14	11.06	120	161	0.09
2-2min	158.66	10.01	142	177	0.10
3-4min	140.63	10.68	119	162	0.14
3-2min	160.46	11.17	140	180	0.11
4-4min	140.63	7.86	127	160	0.13

4-2min	161.91	8.79	145	180	0.13
5-4min	141.74	10.57	124	166	0.11
5-2min	161.03	21.76	51	183	0.23*
6-4min	142.20	10.76	121	162	0.14
6-2min	163.89	9.82	147	182	0.13
STCH	121.09	18.34	26	142	0.26*
AWO	105.77	9.77	87	126	0.08

** The distribution of results in the marked variables deviates statistically significantly from normal distribution*

Legend: AWU – after warm-up; STCH – stretching; AWO – after workout

Table 4 displays the average heart rates in aerobics workout participants in all fifteen variables. The lowest homogeneity of results (s=21.76) is displayed for the variable of the fifth interval lasting two minutes (5-2 min) and the highest (s=7.86) in the variable of the fourth interval lasting four minutes (4-4 min).

The distribution of the results in the variable (5-2 min) deviated statistically significantly from the normal one which means that the yielded value cannot be attributed to the influence of the workout. Such a high variability of results in the test of the fifth interval lasting two minutes (5-2 min) was probably due to the fact that some subjects could not follow the test of a relatively high intensity, which implied the execution of low knee-ups on the spot.

This means that the subjects whose heart rates were high throughout the whole workout could not sustain such intensity, so that to be within the appropriate work range, they would have to substitute the knee-up drill with walking. The results obtained in this research are in compliance with the results obtained by Scharff-Olson et al. (1992) whose results showed that for aerobic dance to produce a response in excess of 50% of VO_{2max}, the target HR must be approximately 80% of the age-predicted maximum heart rate or greater.

The results obtained for the sixth interval lasting two minutes (6-2 min) showed that the distribution of results did not deviate from the normal one. The reason was probably that the subjects knew that this was the last interval in the workout so that they were motivated and did their best.

The second reason might be the different task of the same intensity (alternate knee-ups in a hop). Due to fatigue some subjects executed this task without the hop and in such a case the heart rate was significantly lower. The results obtained for the variable *stretching (STCH)* displayed a significant deviation from the normal distribution.

The reason for such a variability of results might be attributed to the difficulty of workout in question. This means that the subjects who exercised on a regular basis had lower heart rates than those who have not participated in physical exercise for many years. The values of standard deviations increased which means that the results were more homogenous compared to the results of the subjects in the spinning group. The reasons might be attributed to great body mass but also to high values of heart rate at rest in some subjects, their heart rate consequently

achieving the anaerobic threshold more quickly. Another reason could also be the age of subjects (Shimamoto, Adachi, Takahashi, & Tanaka, 1998) or their varying physical fitness level (McCord & Patterson, 1989).

Table 5 *Differences in heart rates between the spinning and the aerobics groups – results of t-test*

	spinning		aerobics		t	df	p
HR	$\bar{x}$	s	$\bar{x}$	s			
AWU	140.86	6.71	145.94	11.04	-2.33	68	.023
1-4min	150.17	5.15	137.69	9.58	6.79	68	.001
1-2min	171.06	5.68	154.74	10.36	8.17	68	.001
2-4min	154.11	8.62	140.14	11.06	5.89	68	.001
2-2min	171.43	6.02	158.66	10.01	6.47	68	.001
3-4min	151.63	8.30	140.63	10.68	4.81	68	.001
3-2min	169.46	6.84	160.46	11.17	4.06	68	.001
4-4min	153.06	7.80	140.63	7.86	6.64	68	.001
4-2min	171.37	6.45	161.91	8.79	5.13	68	.001
5-4min	152.69	10.05	141.74	10.57	4.44	68	.001
5-2min	172.26	5.84	161.03	21.76	2.95	68	.004
6-4min	152.63	9.97	142.20	10.76	4.21	68	.001
6-2min	171.14	7.43	163.89	9.82	3.49	68	.001
STCH	122.34	8.01	121.09	18.34	0.37	68	.711
AWO	104.74	9.34	105.77	9.77	-0.45	68	.654

Legend: AWU – after warm-up; STCH – stretching; AWO – after workout

Table 5 displays the differences between the spinning and the aerobics interval training groups. These results make it possible to conclude that programmes were of different intensity. As we can see, higher heart rate values (HR) could be said to have been found in the spinning interval training programme. Since the differences were found to be statistically different, the conclusion can be made that the programmes were of different intensity. Still, the amount of energy expended during a bout of aerobic dance can vary dramatically according to the intensity of the exercise (Williford et al., 1989). In this case, it is obvious that the program of spinning programmed to reach anaerobic threshold, because both of groups were the similar aged and fitness capabilities. But it is interesting that aerobic group had higher HR values after warm up and in first interval (1-4 min). Reason of that it might be that spinning program is programmed like that because of high intensity in cardio section, what is not in aerobic program. The discussion of results shows that the spinning and the aerobics group participants exercised in the aerobic zone that fell between 150 and 170 (60-75%) of the maximal heart rate and in the anaerobic zone which fell between 160 and 180 (75-90%) of the

maximal heart rate. Consequently the subjects increased their speed endurance and improved their oxygen-transport (Evans, 1997). With the Karvonen's method, the target heart rate must approximate 65% of the maximum heart rate reserve in order to elicit a VO_2 response which is representative of 50% of maximal oxygen uptake.

The results of the *t*-test done to analyse the differences between the two interval training groups pointed to the statistically significant differences between these two programmes ($p<.05$), so that a conclusion may be drawn that these two programmes were not similar regarding the intensity in this case.

Although the goal of aerobic programmes in fitness centres is for the participants to exercise mostly in an aerobic zone, the results of this research, which address the interval type of training, showed that spinning interval training programmes represent high intensity exercise in both intervals (high and low), i.e. exercising in an anaerobic zone, somewhere around the anaerobic threshold. One of the possible reasons for this is that the characteristics of the subjects' oxygen transport system and their aerobic capacity before the inclusion in one of the programmes were low, so that consequently it is to be expected that these features are going to change during season. The goal might be to decrease the heart rate after several months of physical exercise participation which would be an indicator of the improvement of oxygen-transport system characteristics in the subjects.

4 Conclusions

An attempt was made in this paper to research into how two different programmes affect heart rate in subjects of similar age and capabilities. The differences in heart rates between spinning and aerobics interval training were compared, and the yielded results pointed to the differences of the two analysed programmes and to the difference effects that these programmes had on the subjects.

The results of the *t*-test done to analyse the differences between the two interval training groups pointed to the statistically significant differences between these two programmes ($p<.05$). The results in both groups showed high variability at the end of the workout which was due to the evident exhaustion of the subjects and the difficulty of the workout. The second reason was the obesity of some subjects and their previous exercise experience resulting in their heart rate values at rest.

The programmes developed at the very edge of the anaerobic threshold (80-90% of the maximal heart rate), so that it can be said that both programmes were difficult and very strenuous for most subjects. The goal of further treatment, i.e. programme participation is to decrease the heart rate and consequently improve the functioning of the oxygen-transport system.

References

1. BELL J.M., BASSEY, E.J., (1996), *Postexercise heart rates and pulse palpation as a means of determining exercising intensity in aerobic dance class*, British Journal of Sports Medicine, 30(1), 48-52.
2. EVANS, M., (1997), *Endurence Athletes Edge*, Champaign Il, Human Kinectis.
3. FRIED, J., (1997), *Cestovni biciklizam, periodizacija i trening* [*Road cycling, periodization and training*], Zagreb, Gopal
4. JANSSEN, P., (1999), *Lactat Treshold Training*, Champaign Il, Human Kinetics
5. Mc CORD, P., PATTERSON, N.P., (1989), *The effect of low impact dance training on aerobic capacity, submaximal heart rates and body composition of college-aged females.* Journal of sports medicine and physical fitness, 29(2), 184-188.
6. SCHARF-OLSON, M., WILLIFORD, H.N., SMITH, F.H., (1992), *The heart rate VO_2 relationship of aerobic dance: a comparision of target heart rate methods*, Journal of Sports Medicine and Physical Fitness, 32(4), 372-377.
7. SEKULIĆ, D., FURJAN MANDIĆ, G., KONDRIČ M., (2001), *Influence of step aerobics training programme on chosen dimensions of morphological status in males*. Kinesiologia Slovenica, 7(1/2), 44-48.
8. SHIMAMOTO, H., ADACHI, Y., TAKAHASHI, M., TANAKA, K., (1998), *Low impact aerobic dance as a useful exercise mode for reducing body mass in mildly obese middle-aged women*. Applied Human Science, 17(3), 109-114.
9. THOMSEN, D., BALLOR, D.L., (1991), *Physiological responses during aerobic dance of individuals grouped by aerobic capacity and dance experience*. Research Quarterly for Exercise and Sport, 62(1), 68-72.
10. WILLIFORD, H.N., SCHARFF-OLSON, M., BLESSING, D.L., (1989), *The Physiological Effects of Aerobic Dance: A Review*, Sports Medicine, 8(6), 335-345.