THE RHYTHM OF MOVEMENT DURING AQUAROBIC CLASSES

Alicja Nowaczyk Chałupka, Dorota Różańska*, Elżbieta Rostkowska

The Eugeniusz Piasecki University School of Physical Education, Poznań, Poland
**The Józef Piłsudski Academy of Physical Education, Warsaw, Poland*

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The rhythm of movement which is a component of co-ordination motor abilities, present in practically every movement, is a little researched property. Previous studies on the rhythm of movement in humans have always focused on the abilities of motor performance of rhythm by the subjects. They did not explain the mechanism of this performance.

The aim of this study is to present a wide, parametric description of behaviour related to the rhythm of movement, with changes to this behaviour taking place during rhythmic exercise classes. The rhythm of movement of 35 women in aquarobic classes was studied. The classes consisted of 52 exercises the performance of which was analysed in terms of rhythm. The subjects performed also three tests for rhythmic skills.

It was noted that the properties of an exercising person such as rhythmic skills and age, only partially determine maintaining of the rhythm during the exercise. The duration of an exercise has a great effect on the rhythm of movement. A faster pace of an exercise favours maintaining the rhythm. Exercises in which the movement is in the frontal plane are easier to maintain in rhythm than exercises in the median plane. Exercises with alternating sides movement are easier to maintain in rhythm than symmetrical exercises. Similarly, running exercises are easier to maintain in rhythm than jumping exercises. Using equipment during exercises lowers the possibilities of maintaining the rhythm. An interesting phenomenon of "going into rhythm" and "losing rhythm" at various stages of exercises was noted.

The results obtained in this study indicate the complexity of the property called the rhythm of movement. They partly explain the phenomena accompanying the performance of rhythmic exercises by women. The results of the study may be helpful for instructors in preparation of synopses of rhythmic exercise classes.

Keywords: Rhythm of movement, aquarobic, motor exercises in water.

INTRODUCTION

The sense of rhythm of movement is one of the fundamental co-ordination abilities of people (Raczek, 1992).

In spite of the significance of rhythmic skills for efficient motor activities, so far there have been no extensive studies of this phenomenon. There are however many fragmentary studies of the ability of rhythmisation in children, students or athletes.

The studies of Zachopoulou et al. (2000) may be an example. The authors carried out observations the aim of which was to compare the level of rhythmical abilities of children trained in differing sports: tennis, basketball, swimming, and a control group. Children in the swimming group showed the best results in maintaining the rhythm during exercises at a slow and fast pace. Children doing tennis showed a greater rhythmic precision. No statistically significant difference was noted between rhythmical precision and maintaining the rhythm by both sexes.

Phillips-Silver (2005) studied the relations between motor reactions to rhythm and the development of the sense of rhythm in babies. He found that the sense of rhythm in babies may be developed. Babies clearly react with movement to rhythmic features of the music they listen to.

On the basis of the studies carried out by Młodzikowska and Tukiendorf (1991) it may be assumed that success in sport is determined by a high level of the ability of rhythmisation of movements. Motor sense of rhythm in young people develops with age and with specialist training which allows for achieving significant sports results.

The results of the study by Iskra (1999) are quite different. He looked for the significance of rhythmic skills in hurdle races assuming that these skills determine the ability of achieving the rhythm of race characteristic for the hurdlers. His studies did not show statistically significant relations between the results of the rhythmisation test and the results of selected motor fitness tests in the groups of the best Polish hurdlers. The author states however that for testing of rhythmical talents in sport a test with a characteristics of rhythm similar to the rhythm in a given sports event should be prepared.

Stronczyński and Stuła (2003) were interested in the issue of the importance of abilities of movement rhythmisation and sense of musical rhythm in teaching and mastering sports technique based on the example of football. It turned out that players with a better ability of the sense of musical rhythm are more economical in effort and better adapt to set motor structures.

Also, laboratory studies on the sense of rhythm in girls were carried out. They show that there is a tendency toward improvement of results with age and that girls present a higher level of sense of rhythm compared to the population of boys (Gorgól, 1995). Similar studies were carried out by Czabański and Świadek (1995). In the results a significant difference in motor talents in terms of rhythm were noted in the tested female students. Maciantowicz (2002) states that rhythmic movement causes smaller energy loss. Smaller energy loss during movement means more economical movements. In coaching work one should strive to achieve a correct rhythm of the given movements.

However, no one in Poland nor in the world has undertaken the observation and scientific analysis of motor behaviour related to the rhythm of movement in mature women, engaging in physical activity for recreation. The authors of this study were interested not only in the issue of the rhythm of movement, but also in aquarobics becoming more and more popular in the world.

Moving aerobics from a gym to the water environment has made classes more attractive and found many fans. The research so far has confirmed the decrease of fat tissue as an effect of aquarobics (Hoeger et al., 1993). Similar results in subjects exercising on land and in water were obtained by Sanders (1993). The above authors did not however assess the diets of the studied women.

The effect of aqua aerobics on the motor fitness of 18–19 year old girls in Poland was studied by Eider (2004). He used the international test of physical fitness for his study. He found that two months of doing aquarobics affected in a statistically significant way the time of the short and long run, the length of the two-legged jump and the length of time spent in hanging from bent arms. Weiss and Jamieson (1995) as well as Bailey et al. (1997) showed a beneficial effect of aquarobics in the form of an improvement in one's overall sense of well-being, an increase in energy levels and better self-assessment. Piotrowska-Całka (2003) studied also reasons for participating in the classes. The most frequent reason was willingness to improve physical fitness, the need to be active, and also the need for mental relaxation and shaping the figure.

In terms of rhythmic predisposition and abilities to recreate rhythm women are more talented than men. It also results from women's greater inclination and passion for those types of physical activity which are characterised by greater rhythmisation and may be connected with musical accompaniment (Meinel, 1967).

The above discussion leads to the presentation of the aim of the study, which is creating a wide, parametric (measurable) description of behaviour related to the rhythm of movement (rhythmical behaviour) with changes in this behaviour taking place during rhythmical exercise classes.

METHODS

The authors studied the rhythm of movement in women during aquarobics classes. The participants in the classes were 35 women aged 25 to 64. The women exercised in five separate groups with 6, 10, 8, 5 and 6 participants, respectively. In each of the groups 52 exercises were carried out and their performance in terms of rhythm was analysed later. The number of exercises multiplied by the number of women is 1820. This is the number of exercises analysed.

The classes were carried out in a swimming pool 10 by 5 metres wide and 1.20 to 1.40 m deep. The classes took place once a week. The part which was studied took 35 minutes. The remaining time was taken by organisational activities and stretching at the end of the class.

The study involved filming the classes of aquarobics. The camera recorded the instructor's work (the demonstration and the verbal part), performing exercises by the participants and the music. The rhythm of movement recorded on the film was processed into both quality and quantity results using the Pinacle studio computer programme and subjected to statistical and descriptive analysis. Performance of exercises in terms of rhythm was analysed. The authors were most interested in those properties of rhythmic exercises which in the water environment are the drive behind better or worse rhythmic performance by women.

Additionally the participants of the classes were subject to testing of rhythmisation. It involved three tests.

The first one is a special test of the motor sense of rhythm of Bednarzowa and Młodzikowska (1982), modified by the authors for the needs of the studies on the rhythm of movement in women doing aquarobics. The task involved remembering and recreating with body movements (stamping) of the previously observed rhythm of movement at the pace given by the metronome. The results of the test allow for the assessment of the observation skill during observation of movement and of the the ability to immediately imitate. The rhythmic motive used in the task included a pattern with rhythmic values of quavers and crotchets in triple time. The task was performed by each person individually. A correctly performed rhythmic motive was awarded with one point.

Also a test of motoricity to assess the rhythmisation ability devised by Raczek, Mynarski and Ljach (1998) and modified for the purpose of the study was used. The test included two tasks. The first task, "rhythmic tapping with hands", involved mastering an observed cycle of movement and repeating it quickly within 20 seconds on the table top. The second task required placing a subject in a corner of a room, so that her hands adhered to two neighbouring walls. A special cycle of movements made with upper and lower limbs was to be remembered and repeated within 20 seconds. The results of each test was a number of correctly performed cycles within the set time.

The first test of rhythmisation focused on the lower limbs, the second (the first task) on the upper limbs and the third one (the second task) on both the upper and lower limbs.

RESULTS

The research assumption was that the most difficult task was maintaining one's own movement at the correct rhythm dictated by the music and the instructor. Failing to do so results in the appearance of an individual rhythm, the maintainance of which is easier than in the case of correct rhythm. A participant experiencing the greatest difficulties in rhythmisation cannot maintain either the correct nor the individual rhythm.

Results of rhythmisation tests and subjects' age

The results of three rhythmisation tests have been presented in TABLE 1.

The results of the rhythmisation tests focused respectively on the upper and lower limbs and did not show any relation with the women's age. The third test, focused on the lower and the upper limbs together showed a statistically significant relation to age – R. Spearman's –.38 with p = .026. This means that the older the woman, the lower the result of the test.

Maintaining the correct or individual rhythm

Fig. 1 presents the percentage of exercises maintained in the correct or individual rhythm and not maintained in the rhythm separately for each participating woman. And so subjects 8 and 15 maintained most exercises in correct rhythm. Subject 7 exercised in her own individual rhythm for most of the time. Subjects 3, 10, 17 and 18 had the largest difficulties with maintaining any rhythm – they were characterised by the highest percentage of exercises out of rhythm.

The results of the above comparison (Fig. 1) make us believe that maintaining the rhythm or not depends on the individual rhythmisation skills of an exercising person. This is confirmed by the statistically significant relation between the number of exercises maintained in rhythm and the age of the subjects. The older the woman, the fewer exercises she maintained in the correct rhythm (R = –.40, p = .016) and the more in individual rhythm (R = .37, p = .030). The number of exercises completely not maintained in rhythm did not correlate with age.

Studying the relations between the results of rhythmisation tests and the number of exercises maintained in rhythm during classes indicates the usefulness of the second test (focused on the lower limbs) and the third test (upper and lower limbs together) in the assessment of rhythmic abilities. The better the results of these tests, the more exercises the subject maintained in the correct rhythm.

Such a result of comparative and statistical analysis would suggest that other features of an exercise, its duration, pace, type of movement and other properties, do not have such an effect on maintaining rhythm. The following research activities were aimed towards potentially verifying this observation.

Duration of an exercise and maintaining it in the correct rhythm

On the basis of recorded films the duration of each exercise was calculated. The shortest exercise took 6 seconds and the longest one – 165 seconds. For each subject in each exercise the time for which the person maintained her movements in the correct rhythm was calculated.

The exercises were divided according to their duration into long, medium and short lengths, not mechanically, but in accordance with the women's capabilities of maintaining the rhythm. It was found that in exercises lasting for up to 25 seconds the subjects maintained the correct rhythms for at least 40% of the duration of the exercises. These exercises were classified as being short, due to their duration and coping with the rhythm by the subjects (Fig. 2).

Exercises lasting from 26 to 48 seconds were classified as medium-length exercises, as here the subjects went below the threshold of 40% (they maintained the rhythm for less than 40% of the duration of an exercise). A group rhythm appeared. In some exercises of this group all subjects, for 100% of the duration of an exercise, maintained the rhythm, so that there was a group rhythm (Fig. 3). The notion of a group rhythm is another term introduced by the authors, in addition to the correct rhythm and the individual rhythm

Exercises lasting 49 seconds and more were classified as long. In this group there were exercises in which the mean percentage of maintaining the correct rhythm

was equal or close to zero. There was however group rhythm in these exercises (Fig. 4).

The result of the analysis of the relation between the duration of exercises and maintaining the rhythm, separately for each time category confirms the correctness of the above criteria of division of exercises into short, medium and long ones. This relation analysis using Spearman's rank correlation test is statistically insignificant which means a similarity of properties within the group.

The same relation for all exercises in total, shows a statistically characteristic significance (R = –.26 with p = .027), although not a strong one. This means that the longer the duration of an exercise, the more difficult it is to maintain the rhythm.

A small typicality of this relation indicates that other properties, apart from exercise duration, affect the maintainance of rhythm. A further study aims to find these properties.

The pace of exercising and maintaining the rhythm

Another task was dividing exercises by their pace. Pace determines the specific duration of individual rhythmic units, and thus it specifies the speed of performance of the piece. The pace can be slow, moderate or fast. In music for aerobics the term BPM (beat per minute) is used. In exercises with a moderate pace there is one move per each beat. In slow exercises there is a move every second beat and in fast exercises one beat means two moves.

It was calculated that in the whole of the analysed material there were 30 exercises at a slow pace, 184 exercises at a moderate pace and 46 exercises at a fast pace. In TABLE 2 the number of these exercises was multiplied by the number of exercising women.

The highest percentage of exercises maintained in the correct rhythm was for exercises at a fast pace – 52.9 percent, followed by exercises at a normal pace. However, fast exercises were most frequently short exercises, hence the smaller possibility of "losing" the rhythm. A statistical comparison of groups in terms of the rhythm (correct, individual, none) using the U-Mann-Whitney's test, by pace, showed what follows:

- slow and normal exercises – a statistically significant difference Z = 2.8, p = .001,
- slow and fast exercises – a statistically significant difference Z = 2.9, p = .0016,
- normal and fast exercises – a statistically insignificant difference.

The result shows that the subjects maintain the rhythm mainly for fast and normal exercises.

Motor properties of exercises and maintaining the rhythm

Exercises were classified by their qualitative properties related to the type of movement. The following groups of exercises were distinguished:

- exercises where the movement is in the frontal or median planes,
- jumping or running exercises,
- exercises with or without equipment,
- exercises with alternating sides or symmetrical movement,
- exercises on the spot or with moving about.

In this analysis exercises which did not qualify without reservations for any of the groups were rejected.

The analysis using the U-Mann-Whitney test indicates that the rate of performance with the correct, individual and/or no rhythm, with exercises divided into the frontal plane and the median plane, are more favourable for exercises in the frontal plane (Z = –2.03 with p = .042). More exercises in the frontal plane (in a statistically significant way) are performed in the correct rhythm.

With the division of exercises into jumping and running, the difference is distinct in a statistically significant way. Many more running exercises were maintained in the correct rhythm (Z = 6.61 with p = .000).

In exercises without equipment the rhythm was statistically significantly better maintained than in exercises with equipment (Z = 8.18, p = .000).

The participants better maintained rhythm in exercises with alternating sides movement than in exercises with symmetrical movement (Z = 5.76 with p = .000).

No statistically significant difference was found between maintaining the rhythm in exercises performed on the spot and exercises with moving about.

Duration of classes and group rhythm

An observation was carried out in order to determine whether duration of the classes, and hence fatigue, is related to errors in group rhythm. It turned out that it is not related as the number of errors did not correlate with the passing of time of the class.

An abrupt changeability in the frequency of errors during the classes was noted. In the separate analysis of each minute of the class it was noted that most errors occur in the 4th, 14th, 21st, and 26–27th minutes of the classes. When the class was divided into 2 minute units most errors were found in minutes 3–4, 13–14, 21–22, 27–28. The picture of the number of errors with the division of the class into one and two minute units is similar and shows the lack of randomness of the number of er-

rors in time fragments of the classes. Therefore, there is no need to look for further regularities in the relation of the duration of classes and number of errors.

Time intervals between these crisis periods of the class are similar – approximately 10 minutes (Fig. 5). The 7th, 20th, 23–24th minutes and the period towards the end of the class – the four minutes after the 30th minute of the class, are the periods of significant lowering of the number of errors.

A small number of errors occurred in the first three minutes of the class. This is understandable because of the nature of the first exercises. They are warm-up exercises, easy to perform, adapting to water, without the equipment. These exercises occurred at previous classes and are known to the participants. Observation of the exercises in the minutes when the number of errors was the largest and the smallest does not indicate any qualitative properties of exercises at these times.

The phenomenon requires a further analysis, however it indicates the existence of a peculiarity popularly known as "coming into rhythm" or "losing the rhythm".

DISCUSSION

The rhythm of movement which is a component of co-ordination motor abilities, present basically in every movement, is a little researched property. Exercise classes with rhythmic character are getting more and more popular. Most often they are recreational or health classes. In the vast majority of cases they are attended by women. The age of the participants ranges from very young to elderly. Thus researching of the phenomena related to the rhythm of movement is very interesting and becomes more and more needed.

The results of the study presented above turned out to be very interesting. Previous studies on the rhythm of movement in people focused mainly on the abilities connected with motor performance of rhythm in a subject. They did not explain the mechanism of this performance. The reason for a better or worse rhythmic performance was seen only in terms of the motor or psychomotor abilities of a person. The results of the current study show the complexity of the phenomenon of the rhythm of movement. So far no one has indicated types of movement, in terms of motorics and time, which are easier or more difficult to perform rhythm wise. The results of the study such as for example the relation between the rhythm of movement and the duration of a class, indicate the direction for further research.

The results of the study have a great applicable significance not only because of the popularisation of rhythmic exercise classes, but also due to the usefulness of rhythmic abilities in sports, professional and everyday motoricity.

CONCLUSION

The results of the study are a help for instructors in the preparation of class synopses. They partly explain the phenomena which accompany the performance of rhythmic exercises by women. An instructor, when preparing the classes, that is making up the class on the basis of a selection of exercises, may use the results presented in the work as a guide. He or she knows what is the percentage of chance of a correct performance of an exercise depending on its motor and time properties. He or she may predict the difficulties experienced by the participants. By knowing the properties of an exercise which affect the chances of its correct performance an instructor is able to make up exercises appropriate for a given group of exercisers. He or she may use the principle of grading the difficulty – prepare easier exercises for the first class and more difficult later on, as the results of the study show the degree of difficulty of an exercise.

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TABLE 1
Subjects' age and results of rhythmisation tests

	min–max	$\bar{x}$	SD
Age (years)	25–64	44.3	11.3
Rhythmisation test – lower limbs	1–2	1.4	0.5
Rhythmisation test – upper limbs	2–11	5.4	2.5
Rhythmisation test – lower and upper limbs	0–7	3.4	1.8

TABLE 2
Maintaining the rhythm in exercises by their pace

	Pace					
Rhythm	Slow number	%	Normal number	%	Fast number	%
Correct	74	40.4	679	52.9	181	52.9
Individual	65	33.5	333	25.9	89	26.0
No rhythm	55	28.4	272	21.2	72	21.1
Total	194	100	1284	100	342	100

TABLE 3
Maintaining the rhythm in exercises classified by the plane of the movement

Rhythm	Frontal plane number	%	Median plane number	%
Correct	304	53.3	614	47.9
Individual	152	26.7	382	29.8
No rhythm	114	20.0	286	22.3
Total	570	100	1282	100

TABLE 4
Maintaining the rhythm in exercises classified into jumping and running exercises

Rhythm	Jumping exercises number	%	Running exercises number	%
Correct	183	38.3	362	65.6
Individual	189	39.5	91	16.5
No rhythm	106	22.2	99	17.9
Total	478	100	552	100

TABLE 5
Maintaining the rhythm in exercises with or without equipment

Rhythm	Exercises with the equipment number	%	Exercises without the equipment number	%
Correct	587	45.6	347	66.9
Individual	347	27.0	117	22.6
No rhythm	353	24.4	55	10.5
Total	1287	100	519	100

TABLE 6
Maintaining the rhythm in exercises with alternating sides and symmetrical movement

Rhythm	Alternating sides exercises number	%	Symmetrical exercises number	%
Correct	768	57.1	178	41.4
Individual	310	23.0	108	25.1
No rhythm	267	19.9	144	33.5
Total	1345	100	430	100

TABLE 7
Maintaining the rhythm in exercises performed on the spot or with moving about

Rhythm	Exercises on the spot number	%	Exercises with moving about number	%
Correct	864	52.5	74	43.0
Individual	395	24.0	80	46.5
No rhythm	388	23.5	18	10.5
Total	1647	100	172	100

Fig. 1
Percentage of exercises maintained in the correct rhythm, individual rhythm or not maintained in rhythm

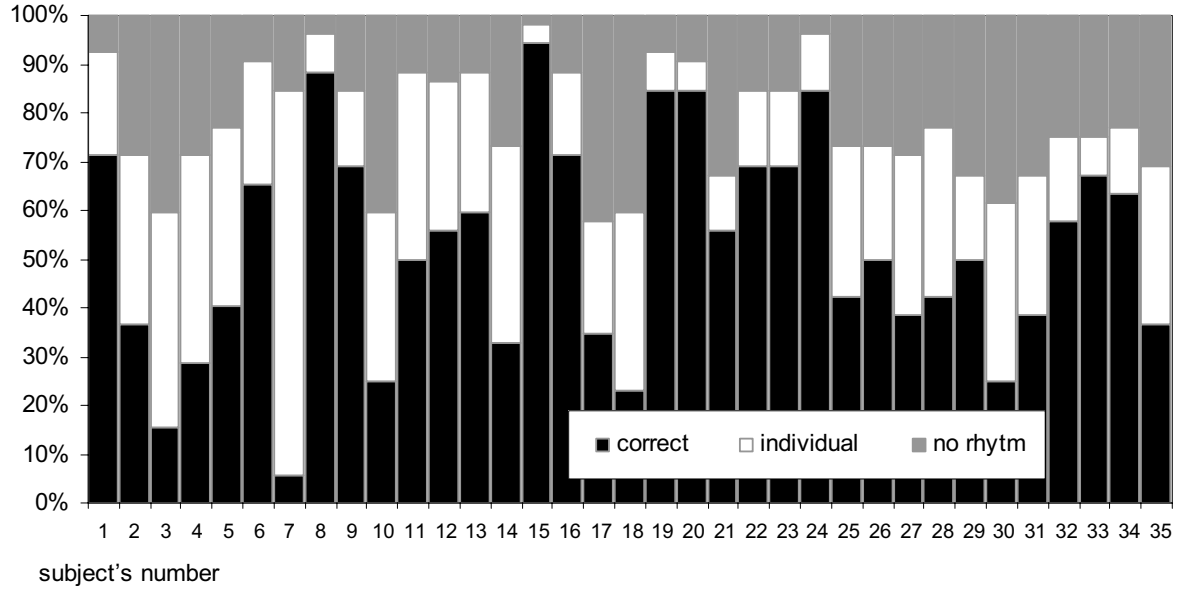


Fig. 2
The group of short exercises – duration and exercises and the mean percentage time of maintaining the correct rhythm

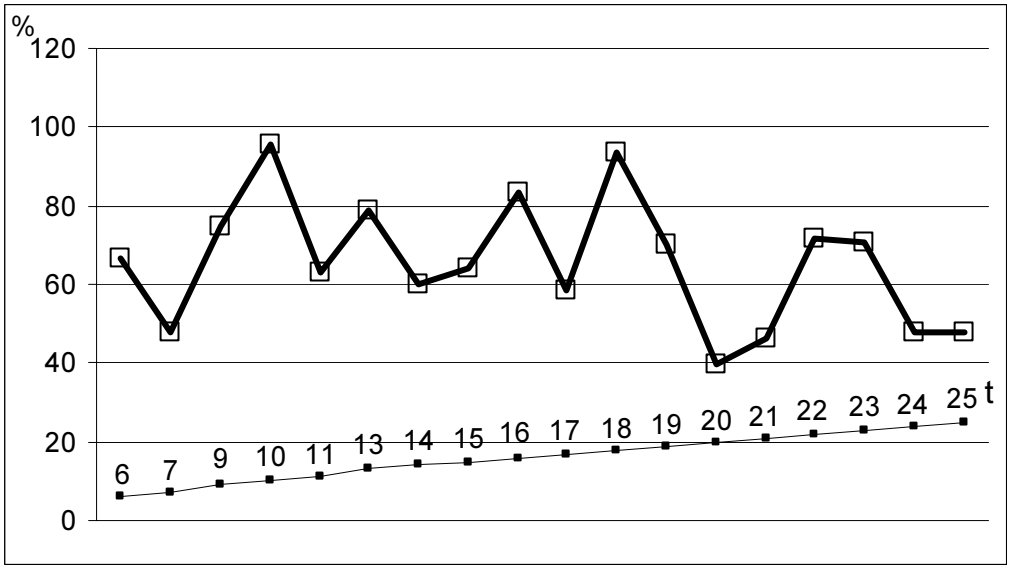


Fig. 3
The group of medium exercises – duration of exercises and the mean percentage time of maintaining the correct rhythm

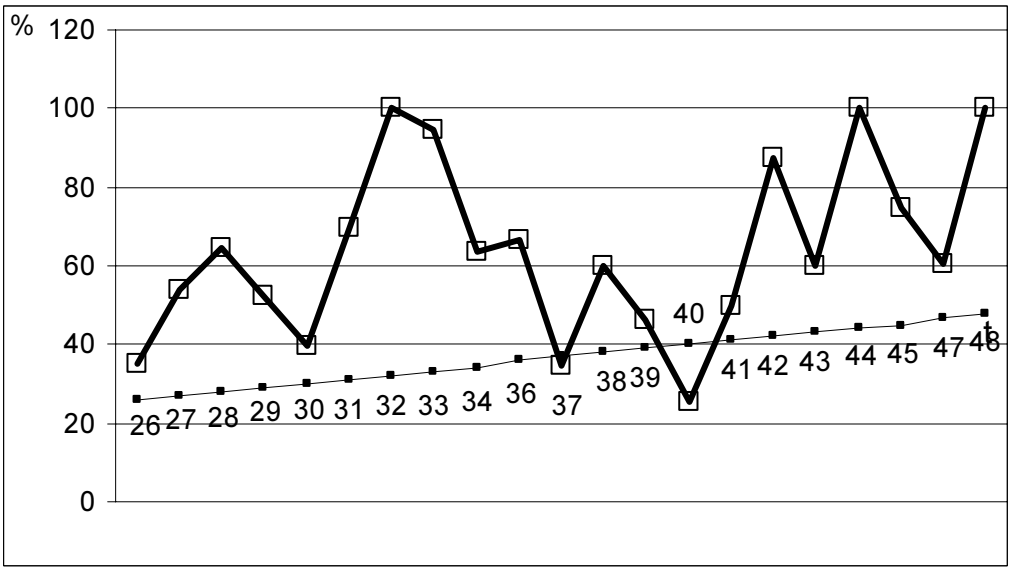


Fig. 4
The group of long exercises – duration of exercises and the mean percentage time of maintaining the correct rhythm

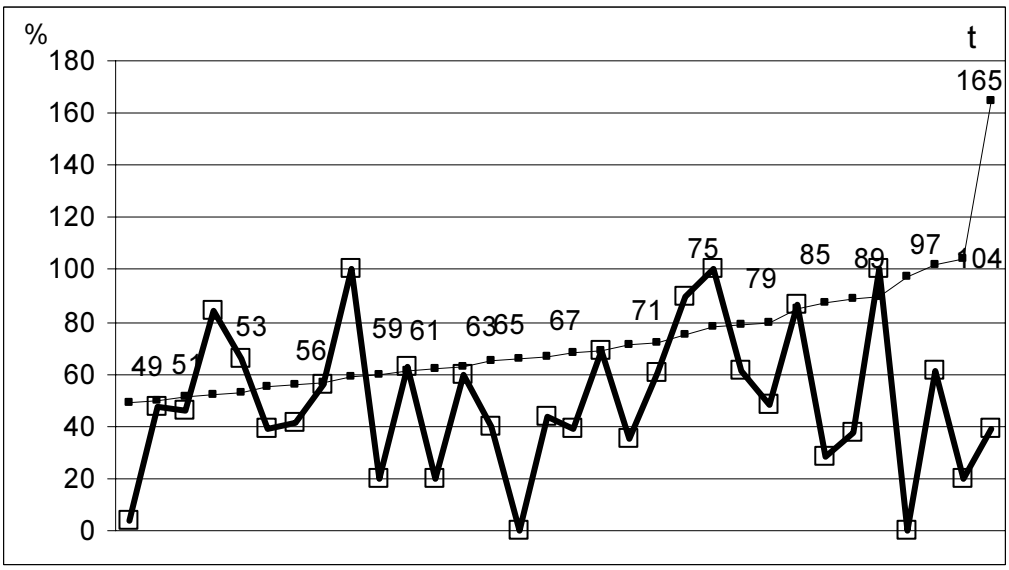
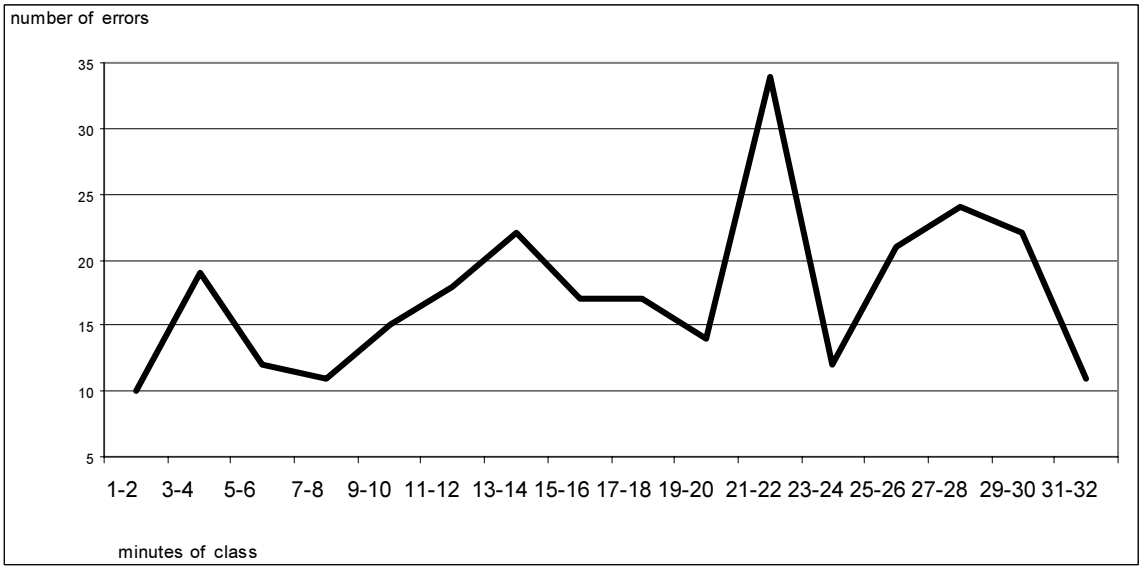


Fig. 5
Number of errors and the duration of the class



POHYBOVÝ RYTMUS PŘI LEKCÍCH AQUAAEROBIKU

(Souhrn anglického textu)

Pohybový rytmus, který je složkou koordinace motorických schopností a který se vyskytuje prakticky u každého pohybu, je málo zkoumanou vlastností. Předchozí studie o pohybovém rytmu u člověka se vždy soustřeďovaly na schopnosti motorického provádění rytmu u subjektů. Nevysvětlovaly však mechanismus jeho provádění.

Cílem této studie je představit rozsáhlý parametrický popis chování souvisejícího s pohybovým rytmem a změny, kterým toto chování během lekcí rytmického cvičení podléhá. Byl zkoumán pohybový rytmus 35 žen při lekcích aquaaerobiku. Lekce sestávaly z 52 cvičení, jejichž provádění jsme studovali s ohledem na rytmus. Subjekty prováděly rovněž tři testy rytmických dovedností.

Zaznamenali jsme, že vlastnosti cvičící osoby, jako jsou rytmické dovednosti a věk, pouze částečně určují schopnost udržet rytmus během cvičení. Na pohybový rytmus měla velký vliv doba trvání cvičení. Rychlejší tempo cvičení podporuje udržení rytmu. Rytmus se udržuje snáze během cvičení, při kterém dochází k pohybu ve frontální rovině, než během cvičení ve středové rovině. Rytmus se udržuje snáze během cvičení se střídáním stran pohybu než během cvičení symetrických. Podobně se rytmus udržuje snáze při cvičení s během než při cvičení se skákáním. Použití vybavení při cvičení snižuje možnost udržet rytmus. V různých etapách byly zaznamenány zajímavé jevy „vstoupení do rytmu“ a „ztrácení rytmu“.

Výsledky získané v rámci této studie naznačují složitost vlastnosti nazývané pohybový rytmus. Částečně vysvětlují jevy provázející provádění rytmických cvičení u žen. Výsledky studie mohou být užitečné pro instruktory při přípravě obsahu lekcí rytmického cvičení.

Klíčová slova: pohybový rytmus, aquaaerobik, motorické cvičení ve vodě.

Alicja Nowaczyk Chałupka, MA

The Eugeniusz Piasecki
University School of PE
Ul. Królowej Jadwigi 27/39
61-871 Poznań
Poland

Education and previous work experience
2002–2006 – school teacher.
2002 – fitness and aqua fitness instructor.
2003 – University School of Physical Education, studies on doctor degree.
Scientific orientation
Motor coordination in aquarobic.