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THE EFFECTS OF MINI-HANDBALL AND PHYSICAL EDUCATION CLASSES ON MOTOR ABILITIES OF CHILDREN OF EARLY SCHOOL AGE

Abstract

The research was carried out on a sample of 48 second-grade male pupils of primary school, divided into an experimental (21 pupils) and a control group (27 pupils). The chronological age of the pupils was eight years. Nine variables were used to assess basic motor abilities: maximum speed in 10m sprint (SPR10M) and 20m sprint (SPR20M), the horizontal jump (MFESDM), sit ups (TRB30S), back extensions (LEĐ30S), the front plank (UPPRED), the figure of eight with a bend (MAGOSS), zigzag run (MAGSLA), and the figure of a star without the ball (ZVIBLO).

In a three-month period, the experimental group participated in a total of 36 mini-handball practice periods, whereas the control group had a total of 36 PE class periods.

There was no significant difference between the measured initial states of the boys in the experimental and the boys in the control group (λ=0.24 and p=0.44), suggesting that both groups had a similar starting position.

The analysis of the experimental group data showed a statistically significant difference in the arithmetic means of the initial and the final measurements for the following basic motor ability variables: maximum speed in 20m sprint (SPR20M), sit ups (TRB30S), back extensions (LED30S), the front plank (UPPRED), and the figure of eight with a bend (MAGOSS).

The analysis of the control group data showed a statistically significant difference in the arithmetic means of the initial and the final measurements only in case of the front plank variable (UPPRED).

The analysis of differences between the results of the boys in the control and the experimental group in basic motor ability tests carried out using the discriminant analysis (λ=0.74 and p=0.01) clearly showed that the experimental mini-handball programme produced much more significant effects on the basic motor ability indicators than the physical education programme in the control group. The results of this study should be taken with great care due to the small sample size on which this study was conducted.

KEY WORDS: *mini-handball, PE classes, boys, changes, basic motor abilities*

INTRODUCTION

The game of mini-handball, designed specifically for younger age groups, was initially promoted in Scandinavian countries, and has only spread to Croatia and other central European countries over the past two decades. At first, this game was played only on the level of school competitions, until sport clubs and handball federations became actively involved in its promotion after having recognised the potential of the game of mini-handball in an early selection of handball players.

The analysis of the specificities of mini-handball and the systematization of the relevant technical elements by learning phases (Šibila et al. 1999 and Špiljak, 2001) as well as the study of

the effects of mini-handball (Bon et al., 2006) have greatly contributed to the introduction of a systematic approach to this sport activity as an integral part of handball and positively affected further development of handball.

Since handball can be introduced as early as at the age of eight, on the level of first four grades of primary education, it is realistic to propose the introduction of mini-handball extracurricular programmes for children at this age. Children at this age can already grasp the aims of the game of mini-handball (Špiljak 2001, Bon 2006). Also, game is the principal exercise method for children of early school age and the implementation of mini-handball programmes can facilitate positive changes in particular anthropological status dimensions, thus building up determinants of pupils' biological development.

This paper sets out to identify the transformative potential of mini-handball as a novel sport activity as compared to the changes occurring as a result of the regular physical education programme currently carried out with 8-year old pupils.

In PE classes pupils are introduced to a great number of elements in a short time period and the question of whether these elements can be successfully adopted and implemented remains open.

On the other hand, the mini-handball programme focused on basic technical elements. The emphasis is on a great number of repetitions and on the mastering of the basic elements, alongside the development of pupils' physical abilities, bearing in mind the respective sensitivity phases.

Taking into account the above, the aim of this paper was to identify the effects of a programmed mini-handball training programme and the regular PE programme on the changes in motor abilities of boys of the early school age attending the second grade of primary school.

Research overview

There have been very few studies analysing the impacts of various sport programmes on the changes of particular anthropological status dimensions. The main reason for this lies in insufficient high-quality sport preparation programmes for children of early school age and a lack of optimal instruments for the assessment of their abilities, characteristics and motor skills.

Only one paper analysing the changes in anthropological characteristics caused by the mini-handball programme has been published (Bojić et al., 2008). This paper focussed on the population of girls of the early school age.

This section presents an overview of research examining general physical abilities and the results of studies examining the effects of programmed PE classes and some aspects of curricular or extracurricular sport activities of children of the early school age. One of the first attempts at assessing the values of a sport activity programme with respect to its effects on anthropological dimensions was the study carried out by Klojčnik (1997). He studied a large sample of subjects (1451) divided into an experimental (795) and a control group (656) over one school year to determine significant effects of training programmes, including a handball programme, on anthropological dimensions of pupils. The sport programmes had a positive effect on the indicators of the psychosomatic status, with the following level of effects, listed in the descending order: track and field, sport gymnastics with acrobatics elements, basketball, volleyball, swimming, handball and football.

More recent studies (Bonacin, 1995; Jozić, 2001; Babin et al., 2001; Katić et al., 2002; Jurak et al., 2007; Erceg et al., 2008; Bavčević et al., 2008; Bojić – Ćaćić et al., 2008; Babin et al., 2010; Selmanović et al., 2012) have in a number of ways approached the question of differentiated education programmes yielding characteristic result.

Bonacin et al. (1995) determined positive effects of a six-month track-and-field training with respect to morphological and motor dimensions of pupils of the first grade of primary school.

Katić et al. (2002) carried out a study on 178 seven-year-old female pupils with the aim of assessing the effects of a six-month track-and-field training programme on the motor ability level, using 12 motor tests. Positive changes in motor abilities of pupils in the experimental group (38), who were included in a well-planned track-and-field training programme were much more significant than those measured in the control group of pupils (140), who were included in the conventional PE programme. In the manifest domain, significant effects of the track and field training programme were identified in aerobic endurance, flexibility, explosive power, balance, and static and repetitive power. Factor analysis revealed significant changes with respect to pupils included in the track-and-field training programme in the second factor, predominantly responsible for changes in coordination and repetitive power; the third factor, responsible for changes in the speed of the frequency of movement and the jump-type explosive power; and the fourth factor, responsible for the throw-type and sprint-type explosive power and endurance.

Jurak et al. (2007) assessed the impact of additional PE lessons programme on motor development of 7- to 10-year old children. A longitudinal study carried out on a sample of 328 pupils found significant differences between the pupils included in sport classes (157) and the pupils in general classes (171) with respect to their morphological characteristics and motor abilities. The pupils in sport classes made more significant progress in the coordination of the entire body. The average value of motor tasks (XT) showed that the motor status of pupils from sports classes was above the Slovenian average (53.11% for boys and 54.53% for girls), whereas that of pupils from the general classes was below the average (47.77% for boys and 49.70% for girls).

Erceg et al. (2008) conducted a study assessing a football programme carried out alongside the PE programme in the first and the second grade of primary school. The effects of the programme on 7-year old (40) and 8-year-old (40) pupils were analysed. For both age groups, control groups consisted of an equal number of pupils (50). Three training units a week were organised over a 9-month period as an additional training building on the conventional PE programme. This resulted in significant changes in several motor dimensions. The most significant changes were observed in the indicators of aerobic endurance, agility and speed in the experimental group of 7-year old subjects, and in the indicators of explosive power, flexibility and speed in the experimental group of 8-year old subjects.

The study by Bavčević et al. (2008) examined changes in morphological and motor characteristics of pupils of the first grade of primary school (age 6-8) included in a sport programme containing elements of track and field, sport gymnastics and sport games, as oppose to those included in the conventional PE programme. The experimental group included in a year-round sport activity programme achieved better results than the control group in the indicators of coordination, flexibility, movement frequency and repetitive and static power. The authors used the results in sprint and ball-throw as the criterion variable. Better results were achieved for the criterion variable in both the experimental and the control group, but in the control group, only small differences were observed in the contribution of the predictor variables.

On a sample of 325 first-grade primary school pupils divided into a control (140) and an experimental group (185), Babin et al. (2010) examined the effects of two kinesiological programmes carried out during one school year. The control group attended regular PE classes, while the experimental group was subjected to an experimental kinesiological programme based on the elements of track and field, sport gymnastics, sport games and global preparatory

exercises. It was important to identify the criteria for the validation of kinesiological programme and, in determining its impact on the transformation of targeted anthropological features, to evaluate both quantitative and qualitative, i.e. structural changes, in the relations of the single partial dimensions of the anthropological status.

Between two points of measurements, both groups showed significant quantitative progress in the area of motor abilities. The positive effects of the experimental programme were reflected in the comprehensive quantitative progress of variables for the assessment of aerobic endurance, static power, flexibility, speed, sprint-type and throw-type explosive power and balance.

Selmanović et al. (2012) analysed effects of a nine-month PE programme and an experimental volleyball programme on a sample of 87 eleven-year-old pupils on the basis of 12 indicators. Both groups showed significant differences between the initial and the final measurement. However, bigger differences in motor ability indicators were found in the experimental group. The highest contribution to the discrimination between the groups in the final status was determined for the explosive power indicators of jump, throw and sprint types.

Finally, a study of particular interest is the one carried out by Bojić – Ćaćić et al. in 2008. The purpose of the study was to assess the impact of mini-handball on the basic and specific ability indicators in girls of early school age. On a sample of 43 eight-year-old girls divided into an experimental (25) and a control group (18), changes in 15 motor variables were analysed, occurring as a result of PE lessons and of mini-handball training programme. Statistically significant differences were found between the initial and the final status in both groups. The most significant positive changes were found in the repetitive power, coordination and agility indicators in the experimental group.

Aim and hypotheses

The aim of the paper was to determine transformative effects of a three-month programmed mini-handball training programme and compare it with the effects of the PE programme carried out in the second grade of primary school.

The following hypotheses were defined:

H1: There are no statistically significant differences between the initial states of pupils in the experimental and the control group.

H2: There are statistically significant differences between the final states of pupils in the experimental and control group.

METHODS

Sample of subjects

The sample of subjects was composed of a total of 48 second-grade primary school male pupils of eight years of chronological age, divided into two groups.

The experimental group was made up of a sample of 21 male pupils attending the same second-grade primary school class, whereas the control group was made up of 27 boys attending another class. All of the pupils were healthy at the time of the initial and the final measurements as well as during the mini-handball training programme and the PE programme. The relatively small sample size of the control and experimental groups is possible to affect the external validity of this experiment.

Practices with the experimental class were organised separately, in a hall meeting the mini-handball experimental programme requirements (mini-handball goals and mini-handball field lines).

Sample of variables

To assess basic motor abilities, nine variables were used: **maximum speed in 10m sprint** (SPR10M), **maximum speed in 20m sprint** (SPR20M), **horizontal jump** (MFESDM), **sit-ups** (TRB30S), **back extensions** (LED30S), **the front plank** (UPPRED), **the figure of eight with a bend** (MAGOSS), **zigzag run** (MAGSLA), **the figure of a star without the ball** (ZVIBLO)

The procedure

Over the three-month period, the experimental and the control group participated in a total of 36 PE class periods (the control groups) or mini-handball practice periods (the experimental group). After an introduction class, during which the pupils were familiarized with the programme (1 class period), four class periods were dedicated to carrying out the initial measurements (4 class periods), while the final measurements were planned for the final four class periods (4 class periods). It follows that the actual programmes were carried out over 27 class periods with both the experimental and the control group.

Exercises, loads and methods that correspond to the specific developmental characteristics of this age group were applied with both the experimental and the control group. Simple exercises for the development of physical abilities and for acquiring the elements of the technique of movement with and without the ball were implemented. The aerobic load was predominantly applied, considering the limited nature of anaerobic capacity of children of this age. Exercise and rest intervals were planned to provide sufficient recovery time. Standard-repetitive, variable, situational and combined exercise methods were used. The basic learning and teaching method was the synthetic method, with the analytic method used as an auxiliary method in the acquisition of motor skills. Information was presented to the boys participating in the practice or PE lessons by means of oral presentation, motor demonstration or performance of simple motor tasks. The most commonly used methodological organisational forms of work were pair work, work in groups of three, parallel group work, parallel alternate group work, and frontal work.

A: PLAN AND PROGRAMME FOR THE EXPERIMENTAL GROUP (MINI-HANDBALL TRAINING)

The experimental mini-handball programme was carried out over a three-month period and it encompassed 36 class periods, with 27 class periods devoted to mini-handball practice, during which programmed exercises, loads and exercise and teaching methods were implemented.

Each mini-handball practice period was divided into five parts: the introductory part (10% = 4.5 min), the preparatory part (20% = 9 min), the main part A (40% = 18 min), the main part B (20% = 9 min), and the closing part (10% = 4.5 min).

Each part of practice periods had predefined characteristics and objectives.

THE STRUCTURE AND OBJECTIVES OF MINI-HANDBALL PRACTICE PERIODS

Introductory part of practice periods

The introductory part of a practice period has the principal objective of creating the organisational and physiological conditions for the practice. This part of a practice period usually begins with the coach's presentation of the practice period objectives. Games are the most common and the most adequate training means used in this part of a practice period. Elementary games, such as "catch", are usually played. Games instantly activate all motor, functional, conative, cognitive and social factors in children. With respect to physiology, games increase the muscle temperature and all of the parameters of the respiratory and blood-transportation functions. In addition to games, running with various tasks and movement structures can be used, preferably using the ball or some other props (rope, stick, etc.).

Preparatory part of practice periods

The objective of the preparatory part of a practice period is to systematically prepare the body for specific physiological loads planned for the main part of the practice, especially the predominantly targeted muscle groups and topological body regions. Global preparatory exercises are mainly used. Depending on the specific objectives of a practice period, they are performed either in place or in motion, individually or in pairs, with or without props. Since the programme involved young children, who are naturally prone to physical activity, the emphasis was placed on dynamic exercises and exercises with props, while static exercises were avoided. Almost every exercise was performed using the ball or some other prop. This type of exercise is also structurally closest to the handball game since it facilitates the learning of the handball technique.

Main part A of practice periods

The main part A of a practice period is a crucial part of mini-handball practice since it focuses on acquiring new and mastering previously acquired motor skills. The mental load is the highest during this period, requiring a high level of attention, whereas the energy load is less intense. Complex methodological and organisational forms are used in the main part A of a practice period.

Main part B of practice periods

During the main part B of a practice period, children usually compete in the handball or some other game (such as relay). In this part, the technical-tactical elements practiced in the main part A are applied in a situational-competitive environment. Specific motor and functional abilities are developed as well. In the main part B, the intensity and energy loads reach their peak. The same is true of the motivation of children. The situational method is the typically used method, whereas circular and station forms of work are the most commonly used methodological and organisational forms of work.

Closing part of practice periods

The focus is on restoring the normal level of emotional, mental and physiological bodily functions and re-establishing the same state that the pupils were in before the beginning of the practice period. Relaxation exercises are usually used in the closing part of a practice period, including passive stretching, muscle relaxation, accuracy, balance and breathing exercises.

PLAN AND PROGRAMME ELEMENTS OF MINI-HANDBALL PRACTICE

A. Learning and teaching *basic elements of movement without the ball*

In the early phase of learning, teaching and practising mini-handball technique elements, procedures for the acquisition of the elementary technique of movement without the ball are implemented. The following elements need to be mastered: parallel and diagonal stance **in the**

offensive play, movement without the ball (establishment of the movement, basic movement and side-step movement, change of direction, slowing down, accelerating), leaps – jumps (double-leg or one-leg jumps), landing (push up, dive, backward roll), feint without the ball, movement without the ball (charging at the ball).
Parallel and diagonal stance **in the defensive play**, movement in the defensive stance, stopping the players, blocking the ball, stealing the ball, interception, the goalkeeping technique, the goalkeeping stance, the goalkeeping movement.
B. In the following phase of learning, teaching and practising mini-handball technique elements, procedures for the acquisition of the technique of movement with the ball are implemented. The following elements need to be mastered:

- **holding the ball,**
- **catching the ball,**
- **passing the ball,**
- **dribbling,**
- **shooting.**

C. Games
Playing games is an appropriate practice method at this age. Games provide a strong motivational stimulus and their variability requires from children timely reactions and creativity in decision-making. The games to be implemented include different types of "catch" and relay games, as well as the game of mini-handball.

D. Additional training means
In the experimental mini-handball programme, additional training means corresponding to the developmental characteristics of the experimental group's age were used. These means involved simple movement structures from track and field, judo and sport gymnastics as well as the exercises for the development of stability and mobility of the locomotor system.

Figure 1: Frequencies of mini-handball programme lesson topics – experimental group

No	TOPICS	MAIN PART A OF THE PRACTICE PERIOD (frequency)	MAIN PART B OF THE PRACTICE PERIOD (frequency)
1	HOLDING THE BALL	11	12
2	CATCHING THE BALL	18	14
3	PASSING THE BALL	15	13
4	SHOOTING	13	11
5	DRIBBLING	16	18
6	BASIC STANCE IN THE OFFENSIVE PLAY	13	10
7	BASIC STANCE IN THE DEFENSIVE PLAY	7	8
8	JUMPS	13	9
9	LANDINGS	10	8
10	FEINTS WITHOUT THE BALL	7	6
11	MOVEMENT WITHOUT THE BALL/CHARGING AT THE BALL	12	9
12	GAMES:		

	a)"catch" games	-	-
	b)relay games	-	9
	c) mini-handball	5	3
13	ADDITIONAL MEANS:		
	a) track and field	6	3
	b) gymnastics	8	-
	c) judo	4	-
	d) strength exercise	16	-
	TOTAL FREQUENCY:	**174**	**133**

B. PLAN AND PROGRAMME FOR THE CONTROL GROUP (PE PROGRAMME)

In the three-month period, the control group participated in a total of 36 PE class periods. After the introduction class, during which the pupils were familiarized with the programme (1 class period), four class periods were devoted to the initial measurements (4 class periods), while the final measurements were planned for the final four class periods (4 class periods). It follows that the actual programme carried out with the control group in the primary school "Marija Jurić Zagorka" included 27 class periods.

The goal of the PE programme in the second grade of primary school is to stimulate qualitative and quantitative changes of primary anthropological characteristics. In particular, this refers to anthropometric characteristics, motor and functional abilities, acquisition of motor skills and the educational effects of the programme.

Each PE class period was divided into five parts: the introductory part (10% = 4.5 min), the preparatory part (20% = 9 min), the main part A (40% = 18 min), the main part B (20% = 9 min), and the closing part (10% = 4.5 min).

Each part of PE periods had predefined characteristics and objectives.

STRUCTURE AND OBJECTIVES OF PE CLASS PERIODS

Introductory part of PE class periods

The objective of the introductory part of a PE class period is psychological and physiological preparation of the pupils for the PE period. The means used in the introductory part can be categorized as running, simple movement structures performed on an unmarked course or around the marked area of the course, and games that are compatible with the purpose of this part of the class period, i.e. their means must be cyclic and they can include elementary group, team and "catch" games.

Preparatory part of PE class periods

The objective of the preparatory part of a PE period is to activate the vital motor abilities and to prepare the locomotor system for the physical activities planned for the main part of the class period. The preparatory part of the period consists of global and special (specific) preparatory exercises. With respect to the movement structure, preparatory exercises can either be performed in place or in motion and with or without props.

The selected preparatory exercises are those that activate the parts of the locomotor system which will be in the focus of the main part of the class and that increase the activity level of primarily those motor abilities that are significantly engaged in the performance of programme means in the main part of the class period.

Main part A of PE class periods

The objective of the main part A of PE class periods is an effective implementation of programme means with the goal of meeting important educational and kinanthropological objectives of individual PE lessons. The main part A can involve three types of activities: learning new motor skills, practicing new motor skills and assessment. In a class focussing on acquiring new motor skills, pupils are for the first time introduced to certain programme means. In a practice class, pupils perform planned elements with the goal of adopting or perfecting these elements and stabilizing and automatising the involved movement. Assessment refers to the implementation of test procedures for the assessment of motor skills, motor achievements or kinanthropological characteristics of pupils. Complex methodological and organisational forms of work are typical in the main part A of PE class periods.

Main part B of PE class periods

The main part B of PE class periods is characterised by situational implementation of motor skills and a high level of activation of pupils' functional and motor abilities. Most commonly used means include sport games, relay games and elementary team games. All the means implemented in this part of a class period are of competitive nature, leading to the highest physiological load intensity in boys. Situational method and circular and station methodological organisational forms of work are typically used.

Closing part of PE class periods

The objective is to slow down the activity of physiological and psychological functions leading to pupils' recovery. Physiological load must be reduced in this part of the class. Various elementary games and relay games can be chosen, as well as different familiar low-intensity motor tasks.

PLAN AND PROGRAMME ELEMENTS OF PE PROGRAMME

The goal of the PE course carried out in the second grade of primary school is to affect quantitative and qualitative changes of primary anthropological characteristics. This refers to anthropometric characteristics, motor and functional abilities and motor skills, and educational effects. Various motor skills are adopted and mastered in PE classes. Procedures for the assessment of motor skills, motor achievements and pupils' abilities and characteristics are carried out.

- ***walking and running,***
- ***jumping,***
- ***throwing, catching and shooting,***
- ***climbing, crawling and creeping,***
- ***lifting and carrying,***
- ***side and front rolling,***
- ***hanging and lifting,***
- ***dance structures,***
- ***games.***

Figure 2: Frequency of PE programme lesson topics – control group

No.	TOPICS	MAIN PART A	MAIN PART B
1	WALKING AND RUNNING	14 repetitions	18 repetitions
2	JUMPING	12 repetitions	12 repetitions
3	THROWING, CATCHING AND SHOOTING	12 repetitions	14 repetitions
4	CLIMBING, CRAWLING AND CREEPING	8 repetitions	10 repetitions
5	LIFTING AND CARRYING	8 repetitions	12 repetitions
6	SIDE AND FRONT ROLLING	10 repetitions	10 repetitions
7	HANGING AND LIFTING UP	6 repetitions	8 repetitions
8	DANCE STRUCTURES	8 repetitions	-
9	GAMES	5 repetitions	14 repetitions
	TOTAL FREQUENCY:	83 repetitions	98 repetitions

Data processing methods

Discriminant analysis was used to determine differences between the initial and the final states of the control and the experimental group.

Analysis of the variance was used to determine the significance level of the differences in basic motor ability variables between the initial and the final states of the control and the experimental group of boys who were subjected to the three-month experimental programmes.

RESULTS AND DISCUSSION

METRIC CHARACTERISTICS OF VARIABLES FOR THE ASSESSMENT OF BASIC MOTOR ABILITIES OF THE SUBJECTS IN THE CONTROL AND THE EXPERIMENTAL GROUP IN THE INITIAL MEASUREMENTS

Figure 3: Central and dispersive parameters of control and experimental group variables in the initial measurements

	AM	Min	Max	SD	Skewness	Kurtosis
SPR10M-K	2.84	2.13	3.70	0.42	0.17	-0.61
SPR10M-E	2.80	2.22	3.72	0.42	0.60	-0.45
SPR20M-K	4.88	3.68	6.30	0.58	0.58	0.69
SPR20M-E	4.80	3.96	6.48	0.64	0.91	0.74
MFESDM-K	126.26	80.00	168.00	21.18	0.03	-0.22
MFESDM-E	137.19	110.00	178.00	14.77	0.95	1.98
MFRTRB-K	18.15	2.00	29.00	6.14	-0.27	1.00
MFRTRB-E	16.95	12.00	26.00	3.38	0.94	1.44
LEĐMAX-K	32.63	14.00	45.00	7.60	-0.53	-0.00
LEĐMAX-E	35.62	20.00	50.00	8.92	-0.16	-0.70
UPPRE-K	86.30	10.00	263.00	56.57	1.48	2.77
UPPRE-E	97.19	10.00	284.00	69.40	1.18	1.38

MAGOSS-K	23.42	0.27	35.22	5.86	-1.96	9.70
MAGOSS-E	22.23	18.87	26.06	2.04	0.01	-0.86
MAGSLA-K	9.20	6.75	11.50	1.41	-0.15	-1.01
MAGSLA-E	8.84	6.09	12.00	1.31	0.24	0.74
ZVIBLO-K	8.03	6.75	10.25	0.87	0.69	0.11
ZVIBLO-E	7.56	6.46	9.62	0.90	0.92	-0.03

The analysis of central and descriptive parameters of the control and the experimental group of boys in the initial and the final state was conducted first. It was found that the variables have satisfactory metric characteristics and are as such suitable for the purpose of the study.

Figure 3 lists basic statistic parameters for the assessment of motor abilities of the subjects in the control and experimental group in the initial measurements. The obtained values suggest an average level of talent in the sample group of pupils, since the results were on the level of the values measured in other similar studies. For example, horizontal jump results (MFESDM) ranging from 126.16 cm in the control group to 137.19 cm in the experimental group correspond to the results obtained by Jurak et al. (2006) on a sample of Slovene boys of the same age. In a study by Babin (2010) carried out on a sample of Croatian boys, measurements yielded somewhat lower results – 111.50cm in the control group and 114.30cm in the experimental group. In the sprint-type explosive power variable, the measured results were slightly higher (4.88s and 4.80s in the control experimental group, respectively) than those obtained by Babin et al. (2010) (4.88s and 4.91s in the control and the experimental group, respectively).

The tests showed a satisfactory level of sensitivity and dispersion, with the results ranging from 3.37 to 4.60 standard deviations. Finally, distribution indicators suggest satisfactory normality of distribution, allowing for further processing of the information obtained in the initial testing.

DIFFERENCES BETWEEN THE RESULTS OF THE BOYS IN THE CONTROL AND THE EXPERIMENTAL GROUP IN THE INITIAL MEASUREMENTS OF MOTOR ABILITIES

The second phase of the research involved an analysis of the differences between the results of the boys in the control and experimental group in the initial measurements (Figure 4).

Figure 4: Significance of the discriminant function of differences between the experimental and the control group *in the initial measurements*

Discriminant function	λ	Rc	W λ	χ^2	df	p-level
1	0.24	0.44	0.81	8.92	**9**	**0.44**

Legend: characteristic values (λ), canonical correlation (Rc), Wilks' lambda (W λ), results (χ^2-test), degrees of freedom
(df) and significance level (p-level)

The discriminant analysis of the initial state results in **basic motor abilities** (λ=0.24, **χ^2 = 8.92** and p=0.44) between the boys in the control and in the experimental group did not show a

statistically significant difference between the two groups of subjects, i.e. the subjects in the two groups achieved similar results in the initial testing (Figure 4). Consequently, objective testing of the hypothesis on the changes in basic motor abilities as a result of mini-handball training programme and PE programme was possible.

DIFFERENCES BETWEEN THE INITIAL AND THE FINAL STATES OF THE CONTROL GROUP AND EXPERIMENTAL GROUP PUPILS

Figure 5: Differences between the initial and the final states of the control and the experimental group as measured by motor ability tests

	AM		SD		N		F		Df		P	
	CG	EG	CG	EG	CG	EG	CG	EG	CG	EG	CG	EG
1-SPR10M – I	2.84	2.80	0.42	0.42								
1-SPR10M – F	2.76	2.59	0.34	0.33	27	21	0.50	3.21	26	20	0.48	0.08
2-SPR20M – I	4.88	4.80	0.58	0.64								
2-SPR20M – F	4.84	4.45	0.40	0.48	27	21	0.08	4.07	26	20	0.78	**0.05**
3-MFEGDM - I	126.26	137.19	21.18	14.77								
3-MFEGDM - F	124.22	143.24	18.69	15.60	27	21	0.14	1.66	26	20	0.71	0.20
4-TRB30S – I	18.15	16.95	6.14	3.38								
4-TRB30S – F	18.22	19.86	4.06	3.69	27	21	0.00	7.07	26	20	0.96	**0.01**
5-LED30S – I	32.63	35.62	7.60	8.92								
5-LED30S – F	35.44	43.19	6.01	7.44	27	21	2.28	8.92	26	20	0.14	**0.00**
6-UPPRED – I	86.30	97.19	56.57	69.40								
6-UPPRED – F	188.19	157.67	156.31	89.39	27	21	10.14	6.00	26	20	**0.00**	**0.02**
7-MAGOSS - I	23.42	22.23	5.86	2.04								
7-MAGOSS - F	23.32	20.87	3.80	1.48	27	21	0.01	6.11	26	20	0.94	**0.02**
8-MAGSLA – I	9.20	8.84	1.41	1.31								
8-MAGSLA - F	9.11	8.45	0.96	0.76	27	21	0.08	1.36	26	20	0.77	0.25
9-ZVIBLO – I	8.03	7.56	0.87	0.90								
9-ZVIBLO – F	8.02	7.36	0.91	0.87	27	21	0.00	0.56	26	20	0.97	0.46

***CG** – control group **EG** – experimental group **I** – initial state **F** – final state*

The next phase of the research focused on examining the effects of the specially programmed mini-handball programme by analysing the differences between the initial and the final states as measured by motor ability tests in the control group (PE) and the experimental group (mini-handball).

The variance analysis was used to test those differences and the results of the analysis are presented in Figure 4. The found indicators point to statistically significant differences between

the initial and the final states in 4 out of 9 motor variables. The measured differences between the initial and the final state that were a result of the PE programme in the control group were much less significant that the differences that occurred as a result of the implementation of the mini-handball programme in the experimental group. Only one statistically significant difference was found in the control group and it referred to the front plank variable (UPPRED).

Much more significant changes were observed between the initial and the final measurements in the experimental group. Statistically significant differences were found for the sprint-type explosive power variable, SPR20M (0.05), the abdominal muscle repetitive power variable, TRB30S (0.01), the back muscle repetitive power variable, LEĐ30S (0.00), the arm and shoulder static power (strength) variable, UPPRED (0.02) and the agility variable, MAGOSS (0.02). This is to show that the mini-handball training programme produced much more significant changes in motor ability indicators than the conventional PE programme. Similar results were obtained by Bonacin et al. (1995.), who compared the effects of a six-month track-and-field training programme to the effects of conventional PE on a similar sample of subjects.

The identified significant changes in the control group in the front plank variable (UPPRED), measuring static power of arms and shoulders, can be ascribed to the PE syllabus for the second grade, which predominantly focuses on climbing, crawling and creeping, thus stimulating the development of arm and shoulder muscles, joints, ligaments and tendons, and increasing the mobility of the spine and joints.

The analysis revealed the effects of mini-handball practice programme (the experimental group) in five motor variables – maximum speed in 20m sprint (SPR20M), sit-ups (TRB30S), back extensions (LEĐ30S), the front plank (UPPRED), and the figure of eight with a bend (MAGOSS). These results can be explained as follows.

Changes in speed in 20m sprint are probably a result of start and start acceleration exercises implemented during the mini-handball programme. A number of practice periods were also dedicated to a correct performance and mastering of basic elements of the sprinting technique. Sensorimotor and neuromuscular coordination factors as well as the sprinting technique factors positively affected the results achieved for this explosive power indicator. Finally, running drills that were used in each practice period included low and high knee skips, heel kick drills and accelerations, which also had a positive effect on the result.

Changes found in the variable measuring the repetitive power of abdominal muscles (TRB30S) *and back muscles* (LEĐ30S) are a result of the applied amount and intensity of activities focusing on strengthening the core muscles. In the part B of practice periods, the emphasis was on core exercises, performed in 3-4 series, each series including 10 – 20 repetitions, separately for the abdominal and for the back muscles. Technical and tactical preparation exercises also engaged back and abdominal region muscles. Consequently, these training means also significantly enhanced the primary strength of this body region.

The significant change in the static power of the arms and the shoulder region measured by the front plank test (UPPRED) was a result of methodological and organisational forms of work of course of obstacles and circular work, in addition to the exercises focusing on this body region. The well-known transfer mechanism seems to have been at play here, accounting for the effect of dynamic activities on primary static power of the arms and the shoulder region.

Finally, a significant increase in the results was measured in the agility test – the figure of eight with a bend (MAGOSS).

Erceg et al. (2008) came up with similar findings in a study assessing the effects of a football programme carried out with first and second grade pupils of primary school.

These changes occurred under the influence of the mini-handball training programme, predominantly focusing on change-of-direction exercises with or without the ball, running, running the hurdles and technical and tactical motor task exercises in the offensive and defensive play.

It may be concluded that the third hypothesis was confirmed, predicting significant changes of basic motor abilities as a result of the programmed mini-handball training programme, including explosive and repetitive power, static power and agility.

A higher sample size and longer training periods would definetly be wanted to assess thoroughly the development of motor abilities under the influence of mini-handball.

DIFFERENCES BETWEEN THE RESULTS OF BOYS IN THE CONTROL AND THE EXPERIMENTAL GROUP IN THE FINAL MEASUREMENTS OF MOTOR ABILITIES

Figure 6: Significance of the discriminant function of differences between the experimental and the control group in the final measurements

Discrim. function	λ	Rc	W λ	χ^2	df	p-level
1	0.74	**0.65**	0.57	22.97	9	**0.01**

Legend: characteristic values (λ), canonical correlation (Rc), Wilks' lambda (W λ), results (χ^2-test), degrees of freedom
(df) and significance level (p-level)

The final phase of the research focused on the analysis of results of the canonical discriminant analysis for determining the *differences between final measurement results of basic motor ability tests for the subjects in the control and the experimental group* (Figure 6).
The revealed differences between the pupils in the control and the experimental group confirm that, generally, the experimental mini-handball programme generated much more significant effects than the PE programme.

Figure 7: Correlations between variables with the discriminant function (structure matrix)

	df 1
SPR10M	- 0.31
SPR20M	- 0.52
MFESDM	0.64
TRB	0.25
LEÐ30S	0.68
UPPRE	- 0.14
MAGOSS	- 0.48
MAGSLA	- 0.44

ZVIBLO	- 0.44

This is confirmed by the discriminant function (p= 0.01) between the two groups of subjects in 9 motor variables (Figure 7).

Their respective correlations with the discriminant function provide information on the individual contribution of each variable to the discrimination between the control and the experimental group. The highest correlation with the discriminant function was found in case of the variable for the assessment of back muscle strength, LEĐ30S (0.68). It was followed by the jump-type explosive power variable, MFESDM (0.64), and the variable for the assessment of the sprint-type explosive power, SPR20M (0.52).

These results suggest that the mini-handball programme more significantly affected these three motor abilities than the PE programme.

Furthermore, it is worth noting that the experimental mini-handball programme had a comparatively high impact on the development of agility – running in the figure of eight (MAGOSS -0.48), zigzag running (MAGSLA -0.44) and running in the figure of a star without the ball (ZVIBLO -0.44)

The discriminant function structure suggests that the mini-handball programme and the implemented training and competition means, with or without the ball, as well as used conditioning and technical and tactical preparation elements, showed much higher level of effectiveness than the PE programme.

The results are coherent with the results of similar studies focusing on other sports, such as the one carried out by Bonacin et al. (1995), proving positive effects of a six-moth track-and-field treatment as oppose to the conventional PE programme; Bavčević et al. (2008), comparing the effects of track and field, sport gymnastics and sport game elements to those of a PE programme; and by Babin et al. (2010), comparing positive effects in the variables of aerobic endurance, static power, flexibility, speed, and sprint- and throwing-type explosive power of a kinesiological programme based on the elements from track and field, sport gymnastics, games and global preparatory exercises with those of a regular PE programme implemented in the control group.

The presented differences between the experimental and the control group of pupils were finally confirmed on the basis of the position of group centroids on the discriminant function (Figure 8).

Figure 8**:** Group centroids

	Root 1
EXPERIMENTAL GROUP	0.99
CONTROL GROUP	-0.77

Pupils from the control group are positioned on the negative pole of the coordinate system (-0.77), whereas the experimental group pupils are located on the positive pole (0.99).

Group centroids are far apart, positioned on the opposite poles, suggesting that the groups significantly differ in the basic motor ability test results.

CONCLUSION

The aim of the study was to analyse the changes in basic motor test results of second-grade primary school male pupils occurring as a result of an experimental mini-handball programme and the conventional PE programme.

On a sample of 48 pupils of 8 years of chronological age, divided into an experimental (mini-handball) and a control group (PE lessons), nine variables for the assessment of basic motor skills were applied. The small sample size used in this study could pose a limitation.

Discriminant analysis was used to determine differences between the control and the experimental group in the initial and the final measurements, and variance analysis was used to compare the initial and the final states in the experimental and the control group.

The analysis of the differences in the *basic motor ability tests* in the control and the experimental group at the initial state did not show significant differences, suggesting that the two groups of pupils had a similar level of motor abilities at the beginning of the research.

The results of the variance analysis showed statistically significant differences between the initial and the final state in 5 out of 9 motor variables in the experimental group of pupils (mini-handball). The differences between the initial and the final state in the control group were much smaller (PE programme), and statistically significant difference was found for only one variable.

In the experimental group, statistically significant differences were found for the variables assessing the sprint-type explosive power, SPR20M (0.05), repetitive power of abdominal muscles, TRB30S (0.01), repetitive power of back muscles, LEĐ30S (0.00), arm and shoulder static power (strength) in the front plank, UPPRED (0.02), and agility, MAGOSS (0.02). In the control group, a statistically significant difference was found only for the front plank variable, UPPRED (0.00).

It was established that the *changes in the motor ability indicators generated by mini-handball practice programme were much more significant than the changes identified in the group participating only in PE lessons. The conclusions of this study could be affected by a low level of external validity due to the small sample size.*

These big differences can be ascribed to the fact that mini-handball elements and the related dynamic motor means with the ball, whose goal is to acquire or master elements of handball technique and develop specific motor and functional abilities, are very close to children's natural movement and are therefore easily adopted and applied in everyday practice and game.

The significantly better results measured in the experimental group were therefore to be expected, since the above mentioned motor skills directly affect the development of motor abilities.

On the other hand, the PE programme for primary school covers a wide range of topics, and the great amount of motor information presented in the short time period did not provide the pupils with sufficient opportunities to achieve the energy load necessary to develop motor abilities.

In conclusion, the study found that the effects on the basic motor ability development of the explosive and repetitive power, static power and agility were much more significant in case of the programmed mini-handball training than in case of the conventional PE programme.

The research in the field of school sports should be furtherly developed, especially in terms of efficency evaluation of specific training programs.

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