

# The Impact of Dance-Aerobics Training on the Morpho-Motor Status in Female High-Schoolers

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## ABSTRACT

*The aim of the study was to analyze the impact of special programmed physical education including dance, aerobics and rhythmic gymnastics on the development of motor and functional abilities and morphological characteristics of female fourth-grade high-schoolers in Zagreb. A total sample of 220 high-schoolers aged 16–18 years were divided into two groups: experimental group of 115 students attending the program composed of dance structures and aerobics, and control group of 105 students attending classic program of physical education. A set of 3 morphological variables, 6 motor variables and one functional variable were applied in both groups on three occasions during an academic year (initial, transient and final measurements). Two-factor analysis of variance (MANOVA repeated measure design) showed the experimental program to significantly influence the development of coordination/agility and specific rhythm coordination, functional aerobic ability, repetitive and explosive strength and flexibility, along with significant reduction of overweight and adipose tissue. Study results clearly indicate that the existing programs of physical education should be revised and replaced by more appropriate ones.*

**Key words:** physical education, dance, aerobics, morpho-motor status, female

## Introduction

The primary goal of physical education classes is to achieve modification of the students' anthropological properties by use of particular contents, modalities, volumes and intensities of educational activities. Educational practice has shown the programs burdened with a lot of educational units to turn motor tasks into the goal *per se* rather than the means to achieve concrete goals during the kinesiological transformation process. In addition, the small volume of work (45 minutes, two times *per week*) and obsolete modalities of performance dictated by the quality of work conditions, level of education and creativity of educators contribute to such an unfavorable situation. The problem is pronounced at the high school level in particular, where a single limiting factor of room and material conditions leads to great differences in the education programming and performance.

Modern sports halls constructed in line with pedagogical standards offer great choice, from conventional ed-

ucational programs through the concepts favoring a particular sport activity. There are a considerable number of predominantly female schools where teachers have to work with large groups of students in a relatively small room almost void of any teaching aids and equipment. When kinesiological treatment is performed in such room and material conditions, and includes high-grade (third and fourth grade) female students known to be difficult to stimulate for conventional physical education, the programming of the training process requires some novel responses, first of all new contents and modalities of work that would correspond to the perceptiveness of the young people. Dance structures are frequently used as a kinesiological operator in educational process, in the form of some isolated elements, compositions, sequences or integral structures within the frame of rhythmic gymnastics, as simplified choreography of folk and social dances, whereas contemporary dance expressions such as jazz,

disco and funk, dance variants of aerobics, and modern dance structures are rarely used or not used at all.

Fragmentary dance structures mostly boil down to a teaching unit (open-closed jump, slow waltz, *sukaĉko kolo*, etc.) which is performed and evaluated in separate as a motor, technique-style task. The concepts in which dance structures make an important teaching unit according to content choice and distribution, components of volume, modalities and work intensity to influence particular segments and anthropological space as a whole, are much more infrequently employed.

Yet, many teachers use dance as an unavoidable kinesiologic operator, its transformation values reflecting in practice, as also scientifically confirmed in a number of studies<sup>1-4</sup>. These and some other studies found the programs of dance aerobics to exert significant effect on morphological structure modification in terms of adipose tissue reduction and development of flexibility and dynamic strength. Continuing the studies demonstrating the value of dance as a kinesiologic operator<sup>2,4-8</sup>, the present study was focused on the utilization of a program consisting exclusively of dance structures, in a form maximally corresponding to all the requirements of the physical education program and curriculum.

The present study was stimulated by the experience collected from the work with female students attending high school where physical education is performed in a relatively small room using a cassette player and occasionally some other technical aid, while students are highly interested in dance structures of various forms, style and expression.

## Subjects and Methods

### *Subject sample*

Study sample was selected from a population of clinically healthy female third- and fourth-grade high school students aged 16–18 years, fit for attending physical education classes. The total sample of 220 students was divided into two groups: experimental group (n=115) and control group (n=105).

Following the experimental procedure, physical education including kinesiologic treatment with programmed components of dance structures and aerobics was used in experimental group throughout the academic year (66 periods). During the same time, control group attended standard physical education curriculum for third- and fourth-grade high school students, also 66 periods in total. Of these, 6 periods were used for initial, transitory and final measurements (2 periods each).

### *Variable sample*

Morphological status was assessed by use of the variables of body height (ABH), body weight (ABW) and adipose tissue percentage (ATP), and motor status by use of the variables of trunk lifting (MTL), standing long jump (MSLJ), sitting forward bow (MSFB), sideward steps

(MSS), non-rhythmic hand tapping (MNT), rhythm test (MRT) and functional ability test (FYMCA).

All the variables mentioned have already been employed in many studies, with the exception of the last two variables, which are therefore briefly explained below.

**TEST FOR RHYTHM ASSESSMENT** – In a room 16 m long and 4 m wide, circles of 25 cm in diameter are marked on the floor, so distributed as to reflect a rhythmic pattern within five two-four times. The test task is to pass the marked field by alternatively jumping to touch each mark on the floor with one foot, except for the last six marks that have to be passed by skipping on both feet. The task is completed when the subject jumps behind the goal line. Number of repeats: three.

**YMCA THREE-MINUTE STEP TEST** – During three minutes, the subject climbs up and down a 40-cm high bench at an even rate of 94 bpm. Upon 5-second exercise discontinuation, the examiner starts counting heartbeats for one minute (as an indicator of recovery rate). Number of repeats: one.

### *Experimental curriculum contents*

Female third- and fourth-grade high school students are best stimulated by dance structures, rhythmic gymnastics and aerobics. In search for a composite of these contents and methods of work that could be performed in very modest conditions, the objective of this study was to find out whether the desired transformation effects could also be achieved by a specifically designed curriculum other than the conventional one.

*Aerobics.* Under the common name of this cyclic activity with a number of favorable effects on the body as a whole, this curriculum included a series of group fitness programs in various forms of direct performance, as follows:

- LO aerobics – aerobics program of 5–30 minutes, consisting of simple choreographic forms of lower intensity (without hopping and jumping), where movement structures are performed with one foot always in contact with the ground. Program tempo: 130–145 bpm;
- HI-LO aerobics includes alternating low and high intensity load upon the entire locomotor, vascular and respiratory systems through progressive discontinuous distribution of these loads. Besides the usual movement structures from the LO aerobics system, their more propulsive variants along with jumping, hopping and running (classic HI impact movement structures), also including plyometry elements, are used in this program. Program tempo: 136–155 bpm;
- STEP aerobics – this program consists of a series of elements performed by climbing up and down a platform. In addition to the type and intensity of performing steps, loading is achieved by the platform height (15, 20 or 25 cm), an adequate number of repeats, and speed of performance. Program tempo: 124–128 bpm; and
- NEW BODY – the main characteristic of the program is the use of small hand weights (0.5–1 kg) to enhance

the work of the upper part of the body, combined with simultaneous aerobics program of lower intensity foot-work. The desired workload is achieved by simple choreographic sequences, carefully determined order of activating small muscle groups, and proper dosage of repeats. Program tempo: 124–132 bpm.

*Dance structures.* Folk dances are integral parts of cultural legacy, whereas social dances play a role in social contacts.

- The folk dances *Staro sito*, *Dučec* and *Drmež* from the ethnochoreological area of Croatian Posavina were analyzed. In addition to the need of including a close area, the selection was dictated by the intention for the educational unit to be in harmony with the overall choice of contents as a potent stimulus of aerobic mode of work to upgrade the students' functional and motor abilities.
- The social dances slow waltz, Viennese waltz, salon polka and rock-'n'-roll were included in the experimental program. Besides mastering the style and technique, these dances were also used as excellent contents to upgrade the students' general endurance, spatial orientation, coordination and speed strength. Each dance was also choreographically processed as an additional informatics program component, motivator and promoter of group interactions.
- Jazz dance – individual movements and 4- and 8-time sequences were unified in 4x32 time (two-four) units. The given choreography was used as a grading element, allowing any choreographic segment to improve in a manner characteristic of and adjusted to an individual. These educational contents served as a motif for students' own creations. The students were free to choose between designing a choreography (at a minimum of 2x32 times) to be performed as a single, pair, or in a group of 3–5 individuals.

*Rhythmic gymnastics.* Exercise without aids in line with minimizing the need of aids was designed using elements from all movement groups (hops, jumps, turns, equilibrium positions, swings, rounds, dance steps) and processed as a sports discipline in 24 three-four times.

Dance structures and rhythmic gymnastics also constituted educational segment (elements for knowledge testing), whereas a part of the program (jazz dance) served as a basis of movement self-expression in the form of individual or group creations accompanied by music by choice.

All contents of the curriculum described were accompanied by appropriate music, so selected as to stimulate good mood and motivate the students for activity, at the same time providing desirable supraliminal stimuli and an adequate level of load.

### Methods of data analysis

On data analysis, the multivariate two-factor analysis of variance with repeated measurements for the multi-dimensional character of the selected variables was em-

ployed. The MANOVA repeated measure design allowed for the morphological-motor status differences between the two groups of students on different kinesiological treatments to assess. The two treatment types were followed using a set of ten measuring instruments at three time points during an academic year. The analysis allowed for the significance of differences between the two student groups on different physical education curricula to determine according to different academic year time points, group interactions and repeated measurements (multivariate tests of significance). The multivariate test for each individual variable was calculated using the same methodology, upon determination of the partial impact of other set variables, thus determining the contribution of each individual variable to the total difference between the groups and treatments. Instead of univariate F tests for particular variables, we used multivariate F test (Wilks' lambda), based on covariance between repeated measurements (redundant information contained in the covariance between the results of repeated measurements). Arithmetic means of the groups according to variables at each point of measurement are graphically presented (experimental group results are presented by full line, and control group results by dotted line).

### Results

The starting, null hypothesis of the experiment assumed the two treatments to equally influence the development of anthropologic variables. However, multivariate test for all variables together (Table 1) yielded significant differences: (a) between experimental and control group; (b) among three repeated measurements during the academic year; and (c) in the interaction of groups on different treatments on three repeated measurements. Accordingly, the null hypothesis was denied, whereas different kinesiological treatments were demonstrated to have different effects on the students' anthropologic development.

Results of F tests with multivariate repeated measurements of ten manifest variables (Table 2) indicated that significant changes occurred in all characteristics (REPEAT) during the academic year observed, i.e. study students exhibited changes in all the characteristics observed irrespective of the activity applied.

At the same time, significant changes (Table 2) were recorded in eight of ten measured characteristics of students on different kinesiological treatments (REPEAT\*GROUP). Not all characteristics contributed equally to

TABLE 1  
MULTIVARIATE TESTS OF SIGNIFICANCE

	Wilks	F	df	Error df	p
Intercept	0.000	67563.78	10	206	0.00
GROUP	0.763	6.39	10	206	0.00
REPEAT	0.128	66.73	20	196	0.00
REPEAT*GROUP	0.451	11.91	20	196	0.00

**TABLE 2**  
MULTIVARIATE TESTS FOR REPEATED MEASURES (Wilks  $\lambda$ , F, p)

Variable	REPEAT			REPEAT*GROUP		
	Wilks $\lambda$	F	p	Wilks $\lambda$	F	p
ABH – Body height	0.87	15.38	0.00	0.99	0.84	0.43
ABW – Body weight	0.79	28.34	0.00	0.91	10.76	0.00
ATP – Adipose tissue percentage	0.64	59.02	0.00	0.92	9.86	0.00
MTL – Trunk lifting	0.51	102.06	0.00	0.89	12.98	0.00
MSLJ – Standing long jump	0.67	52.28	0.00	0.91	10.35	0.00
MSFB – Sitting forward bow	0.62	65.14	0.00	0.91	11.15	0.00
MSS – Sideward steps#	0.34	210.06	0.00	0.76	34.81	0.00
MNT – Non-rhythmic tapping	0.34	212.83	0.00	0.98	2.04	0.13
MRT – Rhythm test#	0.67	52.40	0.00	0.79	27.73	0.00
FYMCA – Functional abilities#	0.46	125.28	0.00	0.76	33.79	0.00

#variable with opposite metric orientation

REPEAT – ANOVA between repeats, REPEAT\*GROUP – ANOVA between repeats and treatments

the explanation of between-group differences on different kinesiologic activities. For example, the subjects' activity had no significant influence on body height and non-rhythmical hand tapping, and these variables followed the rule of their natural development.

Arithmetic means recorded at particular measuring points in the control and experimental group of students are graphically presented to illustrate the pattern of variable modification on different treatments (Figures 1–10). All study students showed a significant and comparable body height increase at all three measuring points during the academic year irrespective of treatments type (Figure 1). The function of body height increase yielded an almost parallel pattern. Experimental group had a greater initial mean body height, and this difference in the mean body height persisted to the end of the study period. The interaction between the repeats and treatments was not significant, and neither treatment type was demonstrated to favor body height increase.

In contrast to body height, body weight did not increase uniformly in the two groups of students during the academic year (Figure 2). In the experimental group, the initially greater body weight decreased, whereas in the control group body weight remained almost unchanged throughout the study period. The interaction of treatments and repeats pointed to significant differences in body weight modification according to the type of physical education during the study period, with dance activities exerting a more favorable effect on body weight changes.

During the academic year, a significant decrease was recorded in the proportion of adipose tissue (Figure 3), however, the effects of different treatments showed significant differences. Control group had a greater mean proportion of adipose tissue on the initial measurement. In this group, the proportion of adipose tissue showed a pronounced reduction for a certain period of time, to be followed by a slower rate of decrease, in contrast to ex-

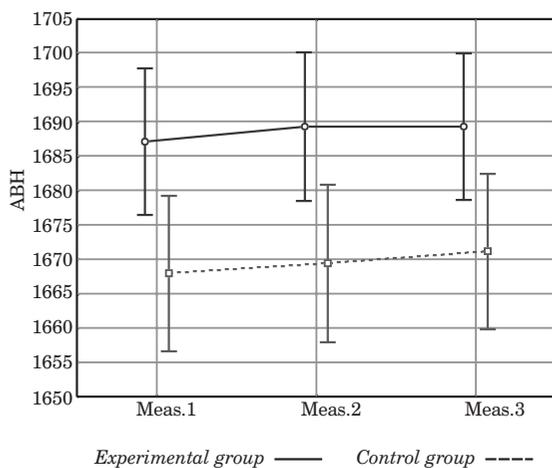


Fig. 1. Arithmetic means of the variable body height (ABH) in study groups according to points of measurement (Meas.).

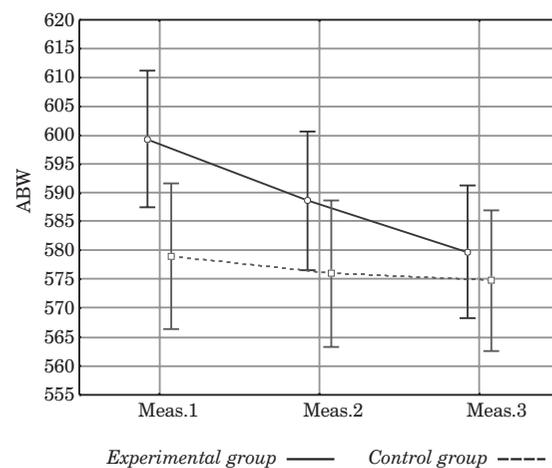


Fig. 2. Arithmetic means of the variable body weight (ABW) in study groups according to points of measurement (Meas.).

perimental group where adipose tissue reduction followed a comparable pattern initially, followed by a faster decline in the second semester of the academic year observed.

The repetitive strength test showed significant modification with time (Figure 4) as well as significant strength changes with the use of different kinesiological programs. Experimental group started with a lower initial mean repetitive strength, to overcome control group with their mean repetitive strength at the end of the first semester, and achieving higher mean value at the end of the academic year, indicating that different physical education curricula differed significantly in their effect on the students' performance. The development of repetitive trunk strength was more efficiently influenced by dance activities than by the classic physical education curriculum.

Like repetitive strength test, experimental curriculum also influenced explosive strength (standing long jump; Figure 5), flexibility (Figure 6; sitting forward

bow), and coordination/agility (Figure 7; sideward steps, with a note that this variable was inversely scaled; in terms of logic, it followed the same pattern as other variables).

During the study period, both student groups changed significantly on the non-rhythmic tapping test (Figure 8), with the initial difference between their means persisting throughout the academic year. The two curricula produced no significant between-group differences (both groups improved during the academic year, however, the interval between the mean sample values remained almost identical from one to another point of measurement).

The specific rhythm test (Figure 9) showed the same pattern of changes with time as the non-rhythmic test. However, on this test significant interactions were recorded, indicating that different programs had significantly different effects on the students, in favor of the experimental group.

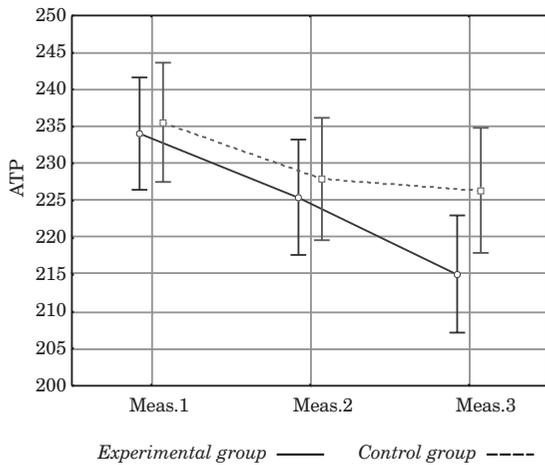


Fig. 3. Arithmetic means of the variable adipose tissue percentage (ATP) in study groups according to points of measurement (Meas.).

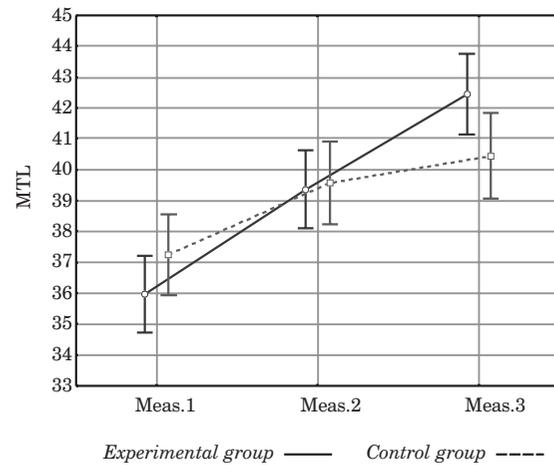


Fig. 4. Arithmetic means of the variable TRUNK LIFTING (MTL) in study groups according to points of measurement (Meas.).

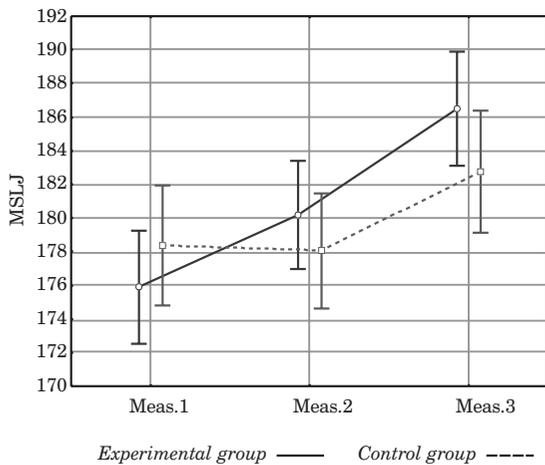


Fig. 5. Arithmetic means of the variable STANDING LONG JUMP (MSLJ) in study groups according to points of measurement (Meas.).

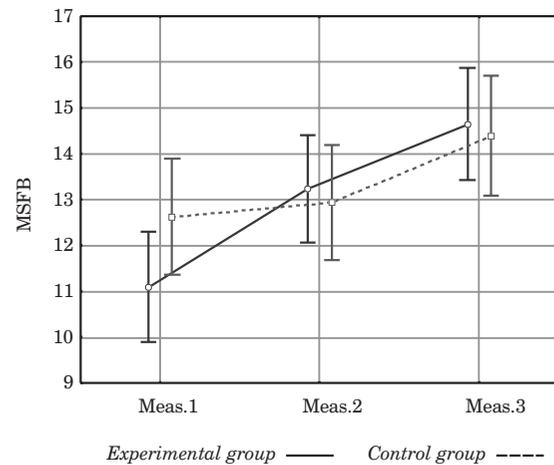


Fig. 6. Arithmetic means of the variable SITTING FORWARD BOW (MSFB) in study groups according to points of measurement (Meas.).

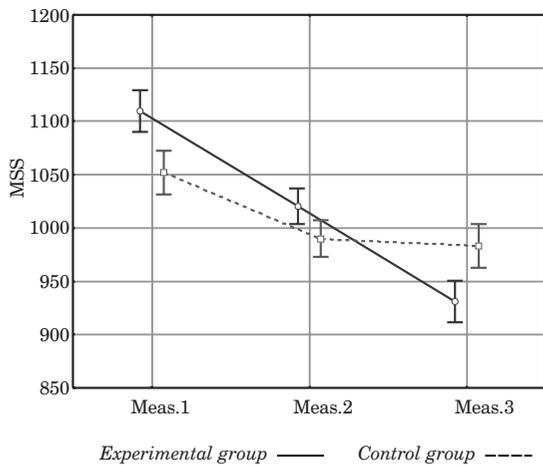


Fig. 7. Arithmetic means of the variable *SIDEWARD STEPS* (MSS) in study groups according to points of measurement (Meas.).

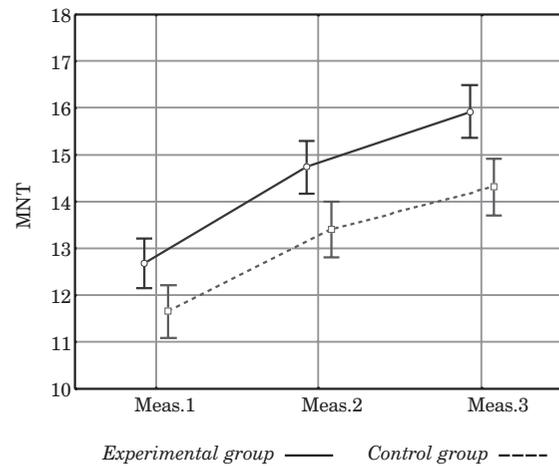


Fig. 8. Arithmetic means of the variable *NON-RHYTHMIC TAPPING* (MNT) in study groups according to points of measurement (Meas.).

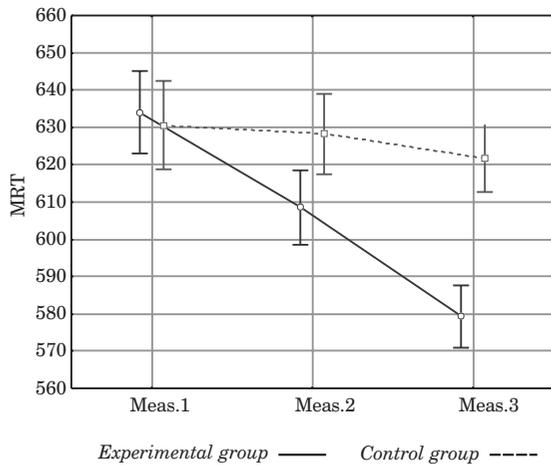


Fig. 9. Arithmetic means of the variable *RHYTHM TEST* (MRT) in study groups according to points of measurement (Meas.).

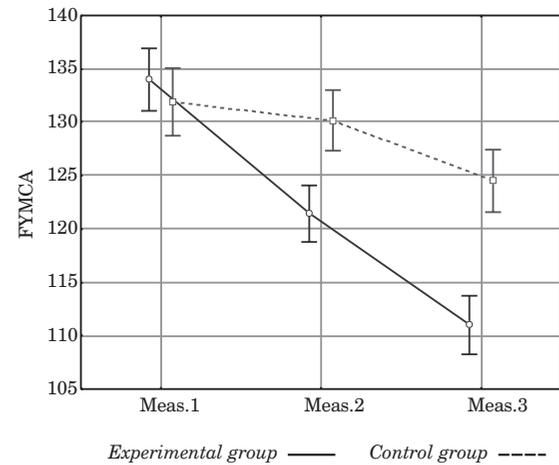


Fig. 10. Arithmetic means of the variable *FUNCTIONAL ABILITIES* (FYMCA) in study groups according to points of measurement (Meas.).

The test of functional ability (FYMCA; Figure 10) was inversely scaled, showing experimental group to have achieved significant improvement over time, while also having attained significantly better shifts in their mean values as compared with the control group.

## Discussion

Study results indicated the program of physical education and health culture with dance, aerobics and rhythmic gymnastics contents to exert significantly greater effects on the development of the morphological-motor status of female high school students than classic physical education curriculum. The changes were more pronounced when observed between particular measurement points than between-group differences recorded at these measurement points. This finding indicated that both treatments, along with the development *per se* in terms of biological continuity of developmental functions, had

favorable accumulation effects that reflected as supra-summation effects of anthropological changes (Table 1).

The greatest changes in the study sample as a whole (Table 2) between measuring points were recorded in the variables of non-rhythmic hand tapping and sideward steps. Non-rhythmic tapping is a test assessing the ability of movement frequency, i.e. psychomotor speed, and is considerably saturated by coordination, with predominantly serial processing of information, whereas the test of sideward steps estimates one of the factors of coordination (agility), which is considerably saturated by psychomotor speed and explosive strength. It is well known that coordination is fully manifested only when other relevant motor abilities saturating coordination have achieved a satisfactory level of development<sup>9-12</sup>. Accordingly, programmed physical education including dance, aerobics and rhythmic gymnastics contents exerted complex effect on the motor development in the female high school students. In addition, considerable changes be-

tween the points of measurement were recorded in functional aerobic ability and repetitive strength of the trunk. Thus, significant development of the strength and endurance occurs at this age, and should be stimulated by use of appropriate kinesiological operators. Changes recorded in flexibility, explosive strength and specific rhythm ability were less pronounced. Concerning morphological system, greatest changes between particular points of measurement referred to adipose tissue reduction, and to a lesser extent to body weight reduction, both being more pronounced in the experimental group.

Upon identification of the general developmental characteristics of the morphological-motor status in female third- and fourth-grade high school students, differences between the study groups and points of measurement (REPEAT\*GROUP) were determined (Table 2). Thus, transformation effects of the two curricula, i.e. experimental and conventional programs, on motor abilities and morphological properties of the students were identified. The appropriately performed varied program composed of folk dances and social dances, various types of aerobics, and elements of rhythmic gymnastics had a complex and significant impact on the morphological-motor status of the students. The impact of the experimental curriculum on agility/coordination was most pronounced. Coordination is an ability type that integrates various movements and/or routines into a unique structure, which is a precondition for quality performance of various movement structures of dance, aerobics and rhythmic gymnastics. Although a significant development of coordination was also recorded in the control group, it was by far more pronounced in the experimental group, both in the first and second semester of the academic year observed. The dance-aerobics training exerted a comparable effect on the test of functional ability, i.e. aerobic endurance, indicating that the work volume

was adequate to provoke changes and development of this basic motor ability<sup>13</sup>, at a comparable rate in the first and second semester. This was followed by the significant impact of experimental curriculum on rhythm ability, i.e. specific coordination integrating different routines and music into a harmonious esthetic movement structure.

Concerning agility/coordination, rhythm ability and aerobic ability, experimental curriculum had a lower yet significant impact on repetitive strength, flexibility and explosive strength, as expected considering the proportional relations of particular transformation operators in the treatment and sensitivity of particular motor abilities in the study sample. Motor changes induced by the treatment reflected in the changes recorded in the students' morphological status, i.e. significant body weight and adipose tissue reduction, thus contributing to the desirable morphological structure of the students.

In conclusion, the program including dance, aerobics and rhythmic gymnastics influenced the relevant motor abilities of coordination (agility and coordination in rhythm), aerobic endurance, strength (repetitive and explosive) and flexibility as well as the morphological status in terms of excessive adipose tissue reduction. Therefore, introduction of such an enriched physical education curriculum for female high school third- and fourth-grade students and university students is strongly recommended.

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## **UTJECAJ PLESNO-AEROBNOG TRENINGA NA MORFO-MOTORIČKI STATUS GIMNAZIJKI**

### **S A Ž E T A K**

Cilj ovog istraživanja je bio analizirati utjecaj posebno programirane nastave TZK uz sadržaje plesa i aerobike, te elemenata ritmičke gimnastike, na razvoj motoričkih i funkcionalnih sposobnosti i morfoloških obilježja učenica završnih razreda srednje škole u gradu Zagrebu. U tu svrhu ukupni uzorak od 220 učenica starosne dobi od 16–18 godina, podijeljen je na dva poduzorka i to na eksperimentalnu skupinu od 115 učenica koja je pohađala program sastavljen od plesnih struktura i aerobike i na kontrolnu skupinu od 105 učenica koja je pohađala klasični program nastave TZK. Na učenicama obje skupine primijenjen je skup od 3 morfološke varijable, 6 motoričkih varijabli i 1 funkcionalne varijable, tri puta u jednoj školskoj godini (inicijalno, tranzitivno i finalno mjerenje). Primjenom dvofaktorske analize varijance (MANOVA repeated measures design), dokazan je značajan i kompleksan utjecaj eksperimentalnog programa na razvoj koordinacije/agilnosti i specifične koordinacije u ritmu, na funkcionalnu aerobnu sposobnost, na repetitivnu i eksplozivnu snagu i fleksibilnost, kao i na značajnu redukciju prekomjerne težine i masnog tkiva. Ovo je dokaz kako postojeće programe TZK treba revidirati i zamijeniti novima.