CORRELATION BETWEEN MOTOR ABILITIES AND THE SPRINT UP TO 60m FROM THE CROUCH START IN ELEVEN-YEAR-OLD FEMALE PUPILS

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Abstract
The research was conducted with the aim of obtaining information on motor abilities and a representative teaching topic Sprint up to 60m from the couch start in eleven-year-old female pupils. A set of 21 motor tests for evaluating motor abilities and a motor skill test Sprint up to 60m from the couch start were applied on the sample of 152 female pupils aged 11 years (± 6 months). The results of the multiple regression analysis showed a high level of correlation between motor abilities and the test Sprint up to 60m from the crouch start in eleven-year-old female pupils (R = 0.77). Analysis of partial contribution of specific motor variables on the significance of regression model showed a statistically significant contribution to the variables Standing on one foot along the balance bench with eyes closed, 20m run from the standing start, and Half squats. The results of this study indicate, on one hand, the importance of choosing teaching topics for Physical Education classes, which would contribute to the highest extent to the transformation of specific motor abilities for achieving intended final conditions, and, on the other, they indicate which motor abilities need to be further developed in order for female pupils to achieve best possible grades in the process of evaluation of this motor skill.

Key words: *motor skills, planning and programming, Physical Education, fifth-grade female pupils.*

Introduction

The term motor information or motor knowledge refers to the formed *command algorithms*, anatomically and functionally represented by corresponding neural structures in the motor zones of the central nervous system that enable the realization of purposeful motor structures of motion. The *command algorithm* is responsible for activating and deactivating different muscle groups with respect to the order, intensity, and duration of one's work, which results in the performance of a particular motor operation (Findak, Metikoš, Neljak, & Prot, 2000; Gallahue & Donnely, 2003).

Motor skills in kinesiology education stand for motor structures of movement whose primary task is the development of particular dimensions of pupils' anthropological characteristics, whereby this is primarily related to morphological characteristics as well as motor and functional abilities. Determining the correlation of motor skills with motor knowledge is still insufficiently researched yet a very topical theoretical and practical problem, which is of particular importance because of the possibility of forming rational procedures for planning, programming as well as monitoring and evaluating during the teaching of Physical Education (here in after PE), including the orientation and selection of young athletes, the planning, programming, and control of the training process, and the effective monitoring of the development of relevant anthropological characteristics of athletes and pupils (Mraković, Metikoš, & Findak, 1993; Findak, 2003).

Pupils must, therefore, be provided with optimal conditions to meet the need to practice all forms and types of motor skills; this must be taken into account especially when programming the PE teaching process (Gallahue & Ozmun, 1998). From all of the above, we can conclude that planned ands ystematicaction on anthropological characteristics of early-school-aged pupils with the optimal use of kinesiological content is not possible without continuous monitoring, testing, and evaluation.

The assessment of motor skills aims to determine the quality and quantity of motor knowledge on which the level of motor achievement depends, whereby the assessment should be carried out throughout the school year. The combination of motor knowledge and motor skills is reflected in the pupils' ability to connect and maximize their use in a particular motor activity in order to achieve the best possible result. As motor achievement is reduced to achieving maximum results in particular motor activities, the purpose of testing them is to identify the pupils' potential. his research was conducted to determine the association between motor skills and the constructed motor knowledge test. Sprint up to 60m from the crouch start, which was taken as a representative teaching topic from the fifth-grade Curriculum. The results of the research will contribute to a better understanding of kinesiology education, especially in the field of planning and programming, and the implementation and control of the physical exercise process (Babin, Bavčević, & Vlahović, 2013).

Methods

The sample of participants included 152 fifth grade female pupils of the chronological age of 11 years (± 6 months) from primary schools in Split, Republic of Croatia. The pupils attended regular PE classes held in accordance with the primary school curriculum (*Primary school curriculum*, 2006). The participants were clinically healthy without any aberrant conditions.

For the purpose of this study, a set of 21 motor tests was used to assess the primary motor abilities, whereby certain dimensions of the hierarchical model of motor abilities were included (Metikoš, Hofman, Prot, Pintar, & Oreb, 1989; Findak, Metikoš, Mraković, &Neljak, 1996; Vlahović, 2012). This led to designing a set of 21 motor tests for assessing the following motor abilities:

- **coordination** – 1) *Polygon backwards* (MRPOL), 2) *Coordination with the stick* (MKOSP), 3)*Side steps*(MAKUS),
- **balance**– 4) *Standing on one foot along the balance bench with eyes opened*(MBU10), 5) *Standing on one foot along the balance bench with eyes closed*(MBU1Z), 6) *Standing on both feet along the balance bench with eyes closed* (MBU2Z),
- **flexibility** – 7) *Over-arm flip* (MFISK), 8)*Bow forward* (MFPRR), 9) *Side steps* (MFBRS),
- **frequency of movement** – 10) *Hand tapping* (MBTAP), 11) *Foot tapping* (MBTAN), 12) *Feet tapping against the wall* (MBTAZ),
- **explosive strength** – 13) *Standing jump* (MESDM), 14) *Backward medicine ball throw* (MEBML), 15)*20 m high-start run* (ME20V),
- **static strength** – 16) *Bent arm hang* (MSVIS), 17) *Backward horizontal hold* (MSHIL), 18) *Half squat standing* (MSIZP),
- **repetitive strength** – 19) *Sit-ups* (MRDTS), 20) *Knees push-ups* (MRSNK), 21) *Half squats* (MRPLC).

Measurements were always carried out at the same time of day in school sports halls, and as a large number of tests were applied with three measurements for each (except for power tests), the participants took part in the measurements three times, at intervals of at least two days. The same measurers, ten of them, measured the same motor tests with the same order of measurement for all participants.

The motor skills test Sprint up to 60m from the crouch start (Vlahović, 2012) was evaluated by seven independent competent and previously educated assessors by directly observing the performance of femalepupils.

The test represented a criterion variable and was formed according to the following description:

Aids: two stands, starting blocks, task picture.

Place of performance: The test is performed on a hard level surface in a sports hall or open space, with a minimum dimension of 70x2 m. The target line is located 60 meters from the starting line. Both lines are parallel and 1.5 m long. Starting blocks are placed in front of the starting line and two stands at the ends of the finish line.

Task: The test is to demonstrate the correct crouch start technique and the fast-running technique while running at maximum speed for a distance of 60 meters from the starting line to the finish line.

Description and proper performance of the test: The participant is standing behind the starting line and approaches the starting blocks at the sign "on your marks." She first places there flex leg on the front block and then the swinging leg on the rear block, taking a position in which the arms are perpendicular to the base, extended for shoulder width, and the body weight is mostly on the legs. At thecommand "get set," the participant raises her hips just above the axis of the shoulders, pushes the shoulders slightly forward, whereby the head should remain in line with the spine. At the start sign, she moves forward, trying to reach maximum speed as quickly as possible in the starting acceleration and maintain it to the finish line. In the first steps following the start, the work of the hand sis very important to keep the body leaning forward. In addition, the speed of the hands determines the frequency of movement.

Although hands work quickly and vigorously, they should not be strained, especially in the shoulder area. Equally important is the position of the head, because its forward or backward tilt adversely affects the position of the body, such that the backward tilt causes the body to prematurely correct its posture, and the forward tilt shortens the steps in initial acceleration. The first steps after the start must be fast and powerful. The foot is placed on the surface with the front part of the foot, moving from front to back. Each subsequent step is longer than the previous one, until it reaches a length of 7 to 8 feet, when the starting acceleration ends. While running at maximum speed, the length and frequency of the steps are stabilized. The reflex leg is fully extended, and the good reflection is enhanced by thestrong work of the arms and the swinging leg. The knee of the swinging leg is raised much higher than the knee level of there flex leg. The leg is actively lowered towards the surface using a "grabbing" movement to the front part of the foot. A very important detail of the running technique is the quick approach of the thighs during the flight phase, which contributes to the faster completion of the steps.

Entering the finish line marks the last 10-15 m, and not "throwing oneself into the finish line." It is important that the running is not stressed in the last meters, and only in the last step, just before the finish line, is the chest or shoulder "thrown" through the finish line. The goal should be to run at full speed, and it is not good to jump or begin to stop a few steps before the finish line. Efforts should be made to run as softly and relaxed as possible.

Evaluation: The test is performed once and grades 1 through 5 are recorded (Table 1).

Table 1. Set evaluation criteria for the variable Sprint up to 60m from the couch start.

GRADE	PERFORMANCE DESCRIPTION OF THE MOTOR KNOWLEDGE TEST
5 (excellent)	- the participant performs Sprint up to 60m from the couch start without any errors
4 (verygood)	- when running, the participant places her foot technically correct but "too firmly" on thesurface - accelerates movements when entering the finish line, but stops immediately
3 (good)	- prematurely begins taking up the upright position after exiting the finish line - does not maintain bent arms or they are inadequately bent in the elbows - does not maintain contact with the surface with the front outside part of the foot but rather with the entire front part of the foot - maintains the basic structure of motion, but it is stiff and "firm" - there is no "entry" into the finish line, but rather slowing down before entering
2 (sufficient)	- poor knowledge of the start command and is slow in taking a crouc hstarting position - delayed exit from the blocks and immediately takes up the upright position - keeps arms outstretched without moving them alongside the body but rather turned outside or inside - does not point the foot in the direction of running but outwards or inwards - maintains contact with the surface with the whole foot or on the heel - is tilted forward orbackward - stops abruptly after entering the finish line
1 (insufficient)	- lacks knowledge of the start command and takes the wrong crouch position - exits the blocks with a long delay and immediately takes up the upright position - has legs extended at the knee joint while running - lacks synchronized work with the hands, which makes it difficult to establish coordination with the feet - maintains full contact with the surface with the whole foot - shows a "waddling" basic structure of motion - maintains an upright position throughout the run - stops a few steps before the finish line

In order to obtain a correlation indicator between the set of variables of manifest motor skills and the variable of motor knowledge for Sprint up to 60m from the couch start, a multiple regression analysis was applied and used to calculate: coefficient of multiple correlation*(*R*),* coefficient of determination*(R^2),* standard deviation of the error*(σ),* F-test value*(F),* standardized regression coefficient *(β),* linear correlation coefficient of the predictor variable and the criterion*(r),* t-test value*(*t*),and*significance level*(*p*).* The software package Statistica for Windows 13.3 was used for the analysis of obtained data.

Results

Table 2. Multiple regression analysis; criterionvariable – Sprint up to 60m from the crouch start, predictor set - motor variables.

R = 0.77	R^2 = 0.59	σ_e= 0.48	F = 8.60	p = 0.00
Variable	**β**	**r**	**t**	**p**
MRPOL	-0.15	-0.14	-1.56	0.12
MKOSP	0.15	0.17	1.90	0.06
MAKUS	-0.01	-0.01	-0.13	0.90
MBU1O	**0.22**	**0.25**	**2.88**	**0.00**
MBU1Z	-0.13	-0.17	-1.86	0.06
MBU2Z	-0.09	-0.12	-1.36	0.18
MFISK	-0.06	-0.07	-0.77	0.44
MFPRR	-0.03	-0.03	-0.35	0.73
MFBRS	0.12	0.13	1.47	0.14
MBTAP	-0.10	-0.12	-0.30	0.20
MBTAN	0.11	0.12	1.29	0.20
MBTAZ	-0.04	-0.05	-0.51	0.61
MESDM	0.13	0.11	1.27	0.20
MEBML	-0.02	-0.03	-0.34	0.73
ME20V	**-0.21**	**-0.22**	**-2.50**	**0.01**

MSVIS	0.12	0.12	1.29	0.20
MSHIL	0.07	0.08	0.88	0.38
MSIZP	0.00	0.00	0.02	0.98
MTDTS	0.13	0.15	1.63	0.11
MRSNK	0.03	0.04	0.39	0.70
MRPLČ	**0.17**	**0.19**	**2.11**	**0.04**

Legend: R – coefficient of multiple correlation; R^2 – coefficient of determination; σ_e – standard deviation of the error; F – F-test value; β – standardized regression coefficient; r – linear correlation coefficient of the predictor variable and the criterion; t –t-test value; p – significance level; MRPOL – Backwards obstacle course; MKOSP – Coordination with the stick; MAKUS – Side steps; MBU1O – Standing on a foot along the balance bench with eyes opened; MBU1Z – Standing on a foot along the balance bench with eyes closed; MBU2Z – Standing on the feet along the balance bench with eyes closed; MFISK – Over-arm flip; MFPRR – Bow forward; MFBRS – Side steps; MBTAP – Hand tapping; MBTAN – Foot tapping; MBTAZ – Feet tapping against the wall; MESDM – Standing jump; MEBML – Backward medicine ball throw; ME20V – 20m high-start run; MSVIS – Bent arm hang; MSHIL – Backward horizontal hold; MSIZP – Half squat standing; MRDTS – Sit-ups; MRSNK – Knees push-ups; MRPLC – Half squats.

The results of multiple regression analyzes in the sample of female pupils indicate a significant amount of correlation between the predictor set of motor variables and the criterion variable *Sprint up to 60m from the crouch start.* The coefficient of multiple correlation (R = 0.77) indicates that a significant part of the variability of the criterion variable can be attributed to the influence of the predictor set of variables. The statistical significance of the regression model was confirmed by applying the F-test (F = 8.60; p = 0.00) so that the model can be considered predictively valid. The value of the coefficient of determination (R2 = 0.59) indicates a statistically significant amount of common variance of the predictor set of motor skills and the criterion variable. The standard deviation of the error (σe = 0.48), as an indicator of the standard deviation of the dispersion of the measured results around the regression direction, indicates a satisfactory degree of representativeness of the regression model.

The analysis of the partial contribution of individual predictor variables in defining the significance of the regression model, has revealed a statistically significant correlation for three predictor variables. The variable *Standing on one foot along the balance bench with eyes opened* (MBU10) shows the highest amount of contribution to the prediction of the criterion variable with a regression coefficient of 0.22 and a partial regression coefficientof 0.25. Statistical significance was confirmed using the t-test (t = 2.88; p = 0.00). The *20 m high-start run* (ME20V) variable is the second largest contribution to the significance of the regression model with a standard regression coefficient of -0.21, and it correlates with the criterion variable of -0.22. These findings were confirmed using the t-test (t = -2.50; p = 0.01). The third largest contribution to the criterion prediction is the motor variable *Half squats* (MRPLC) with a regression coefficientof 0.17 and a linear correlation coefficient with a criterion variable of 0.19. These findings were confirmed by t-test results (t = 2.11; p = 0.04) (Table 2).

Discussion and conclusion

In this research, which was conducted on a sample of 152 fifth-grade female pupils from primary schools in Split, Republic of Croatia, the aimwas to determine the correlation between motor skills and motor knowledge in *Sprint up to 60m from the crouch start*. The results of the multiple regression analysis show that a significant amount of variance in the criterion variable can be attributed to the influence of the predictor set of manifest motor variables.

The findings of the partial contributions of individual variables of motor ability indicate that, in defining the *criterion variable Sprint up to 60m from the crouch start, the most informative motor variables are Standing on one foot along the balance bench with eyes opened* (MBU10), *20m high-start run* (ME20V), which has been expected, and *Half squats* (MRPLC). The presence of a synergy and tone control mechanism, in this finding of the balance on one leg with the eyes opened, most likely corresponds to the current support of one leg at the moment of take off from the surface, thereby directing the trajectory of movement in forward running.

As the quality of the kinesiology education process depends on a number of factors; among the crucial ones is certainly knowing not only the current state of pupils' abilities, traits, and knowledge but also the transformative values of certain teaching contents. The results of this research show an insight into the structure of the connection between the Sprint up to 60m from the crouch start and motor skills in fifth-grade pupils. The above mentined points to the importance of choosing this teaching topic in the process of organizing PE education classes for the transformation of particular motor skills, all with the aim of achieving desirable final conditions in the anthropological characteristics of eleven-year-old female pupils. Also, the results indicate which motor skills should be prioritized in order to achieve better results in the assessment of this teaching content in the process of monitoring and evaluation.

Therefore, the results are directly applicable in the teaching of PE as a foundation for understanding the specification models of particular kinesiological structures and, consequently, a significant factor in optimizing the planning, programming, and implementation and evaluation of the kinesiology education process (Vlahović, Babin, B., & Babin, J., 2016).

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