Relations Between Morphological Characteristics and the Motor Skill Handstand Against "A Vertical Surface in 11-Year-Old Female Pupils"

Povezanost morfoloških karakteristika i motoričkog znanja "stoj na rukama uz okomitu plohu kod jedanaestogodišnjih učenica"

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Abstract: *The aim of the conducted research was to determine correlation between morphological characteristics and the motor skill Handstand Against a Vertical Surface in fifth-grade primary-school female pupils from Split. In conformity with the set objective, on the sample of 152 primary-school female pupils from Split, Republic of Croatia, aged 11 (± 6 months), a set of 16 anthropometric measurements for assessment of morphological characteristics and the motor skill test Handstand Against a Vertical Surface, were applied. The results for multiple regression analysis indicated a statistically significant correlation between morphological characteristics and the motor skill Handstand Against a Vertical Surface in female students. The analysis of partial contribution of certain morphological variables on the significance of the regression model indicated a statistically significant contribution in the variables Abdomen Skinfold and Elbow Diameter. The research results provided useful information on morphological specification of the motor skill Handstand Against a Vertical Surface and thus its role in transformation of certain morphological characteristics for achieving desired final conditions in the process of planning and programming Physical Education classes. Moreover, they also imply which morphological characteristics should be considered in order for female pupils to achieve best possible results during the assessment process of this motor task.*

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

Sažetak: *Cilj istraživanja bio je utvrditi povezanost između morfoloških karakteristika i motoričkog znanja „Stoj na rukama uz okomitu plohu" kod učenica petog razreda osnovnih škola u Splitu. Sukladno cilju istraživanja na uzorku od 152 učenice u dobi od 11 godina (± 6 mjeseci) primijenjen je skup od 16 antropometrijskih mjera za procjenu morfoloških karakteristika i test motoričkog znanja „Stoj na rukama uz okomitu plohu". Rezultati regresijske analize pokazali su statistički značajnu povezanost morfoloških karakteristika s motoričkim znanjem „Stoj na rukama uz okomitu plohu" kod učenica. Analiza parcijalnog doprinosa pojedinih morfoloških varijabli na značajnost regresijskog modela ukazala je kako statistički značajan doprinos imaju varijable Kožni nabor trbuha i Dijametar lakta. Rezultati istraživanja pružili su korisne informacije o morfološkoj specifikaciji motoričkog znanja „Stoj na rukama uz okomitu plohu" pa time i njegove uloge u transformaciji pojedinih morfoloških karakteristika za postizanje željenih finalnih stanja u procesu planiranja i programiranja u Tjelesnoj i zdravstvenoj kulturi. Također, ukazuju i na to koje morfološke karakteristike treba uvažavati kako bi u procesu praćenja i vrednovanja učenice postizale što bolje rezultate kod ocjenjivanja ovog motoričkog zadatka.*

Ključne reči: *motorička znanja, učenice petih razreda, Tjelesna i zdravstvena kultura.*

Introduction

Kinesiological motor skills represent motor structures of movement with the primary function of development of

Uvod

Kineziološka motorička znanja predstavljaju one motoričke strukture kretanja čija je primarna funkcija razvoj pojedinih dimenzija antropološkog statusa učenika, i to u prvom redu morfoloških i motoričkih obi-

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individual dimensions of the anthropological status of pupils, and particularly of morphological and motor characteristics. Therefore, the primary value of the mentioned skills lies in the possibility that each anthropological characteristic of pupils changes according to a predefined desired objective (Babin, Bavčević and Prskalo, 2010).

According to Findak (2003) the quality of the process of kinesiological education depends on a whole range of factors, the crucial ones being knowing the current condition, abilities, characteristics and skills of pupils on one hand, and transformational values of individual kinesiological operators, that is the teaching content on the other. Motor skills in kinesiological education represent motor structures of movement aiming primarily to, besides acquiring certain skills, the development of individual dimensions of anthropological status, and first of all of morphological, motor and functional characteristics of pupils. Since the primary value of motor skills is their immediate impact on transformation of individual anthropometric characteristics, it is of crucial importance, through a right selection of motor skills during planning and programming of Physical Education classes, to ensure maximum changes in each anthropometric dimension of pupils to the level of achieving desired final conditions.

Gabard (1992) and Sanders (1992) pointed out that the set of motor skills should be given special attention during childhood, i.e. in preschool education and during the period of the youngest school age. Due to the mentioned, crucial role is played both by parents and all institutions that implement educational programmes, while the teachers of kinesiology play a particularly important role (Venetsanou and Kambas, 2009). Therefore, pupils must be provided with optimal conditions for meeting requirements for practicing all forms and types of motor skills, which must be taken into account when programming the teaching process in Physical Education (Gallahue and Ozmun, 1998).

Determining relations between morphological characteristics and motor skills has still been insufficiently investigated, but it has been an ongoing theoretical and practical problem that is of great importance, primarily due to the possibility of forming rational procedures for planning, programming, and monitoring or assessment in Physical Education, as well as for orientation and selection of young athletes, planning, programming and monitoring the training process, and effective monitoring of the development of relevant anthropological characteristics of athletes and pupils (Vlahović, 2012). When choosing teaching contents for teaching in Physical Education, it is necessary to consider the method of selection that would include dynamics and the level of development of those morphological character-

lježja. Stoga je primarna vrijednost navedenih znanja u mogućnosti da se pojedina antropološka obilježja učenika mijenjaju prema unaprijed definiranom željenom cilju (Babin, Bavčević i Prskalo, 2010).

Prema Findaku (2003) kvaliteta procesa kineziološke edukacije ovisi o nizu čimbenika, a jedan od presudnih je poznavanje, kako aktualnog stanja, sposobnosti, osobina i znanja učenika, tako i transformacijskih vrijednosti pojedinih kinezioloških operatora, odnosno nastavnih sadržaja. Motorička znanja u kineziološkoj edukaciji predstavljaju motoričke strukture kretanja čija je osnovna zadaća, pored učenja određenih vještina, razvoj pojedinih dimenzija antropološkog statusa, a prije svega morfoloških, motoričkih i funkcionalnih obilježja učenika. Kako je primarna vrijednost motoričkih znanja njihov neposredni utjecaj na transformaciju pojedinih antropoloških obilježja od velike je važnosti pravilnim odabirom motoričkih znanja, kod planiranja i programiranja u nastavi Tjelesne i zdravstvene kulture, omogućiti maksimalne promjene pojedinih antropoloških obilježja učenika i to do razine poželjnih finalnih stanja.

Gabard (1992) i Sanders (1992) ističu kako skupu motoričkih znanja treba posvetiti posebnu pažnju tijekom djetinjstva tj. u predškolskom odgoju i najmlađem školskom uzrastu. Za navedeno, presudnu ulogu imaju kako roditelji tako i sve institucije koje ostvaruju odgojno-obrazovne programe, a posebno značajnu ulogu imaju nastavnici kineziologije (Venetsanou i Kambas, 2009). Učenicima se stoga moraju pružiti optimalni uvjeti za podmirenje potreba za uvježbavanjem svih oblika i vrsta motoričkog znanja, a o čemu se posebno mora voditi računa pri programiranju nastavnog procesa u Tjelesnoj i zdravstvenoj kulturi (Gallahue i Ozmun, 1998.

Utvrđivanje povezanosti morfoloških karakteristika s motoričkim znanjima još uvijek je nedovoljno istražen, ali veoma aktualan teorijski i praktični problem koji je od izrazitog značaja, prvenstveno zbog mogućnosti formiranja racionalnih postupaka za planiranje, programiranje te praćenje i vrednovanje u nastavi Tjelesne i zdravstvene kulture, kao i za orijentaciju i selekciju mladih sportaša, planiranje, programiranje i kontrolu trenažnog procesa te efikasno praćenje razvoja relevantnih antropoloških obilježja sportaša i učenika (Vlahović, 2012). Pri odabiru nastavnih sadržaja u nastavi Tjelesne i zdravstvene kulture potrebno je uvažavati način odabira koji bi sadržavao dinamiku i stupanj razvoja onih morfoloških karakteristika koje najviše doprinose usvajanju pojedinog motoričkog znanja te imati što više informacija o povezanost svih segmenata antropološkog statusa u postupku usvajanja motoričkih znanja učenika.

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istics that contribute most to the acquisition of individual motor skill and that would provide as much information as possible on the relationship of all parts of anthropological status in the process of acquiring motor skills by pupils.

However, in order to adequately apply motor skills in kinesiological education, it is important to respect age, given that it must be based on the biological level of development of individual anthropological characteristics of pupils in each stage of growth and development. Only adequate motor skill can be effectively acquired, which is a prerequisite for it to simultaneously assume the function of an adequate kinesiological stimulus in the development of anthropological characteristics of pupils (Vlahović and Babin, 2018). It is also a prerequisite for a certain motor skill to acquire at the same time the activity of an appropriate kinesiological stimulus in order to reach the desired level of anthropological characteristics of female pupils.

Vlahović, Babin, B. and Babin, J. (2016). investigated relations between morphological characteristics and motor skills of representative teaching topics from the official Physical Education curriculum for primary-school fifth-grade female pupils. Thus, sixteen anthropometric measures for the assessment of morphological characteristics and seven tests of representative teaching topics for the assessment of motor skills were applied on a sample of 152 female pupils, aged eleven. The results of canonical correlation analysis, conducted between the system of morphological variables and the variables of motor skills of female pupils, showed that one pair of statistically significant canonical factors with a canonical correlation coefficient of 0.61 (p = 0.00) was isolated. The structure of relations of an isolated significant pair of a canonical root showed that female pupils who got better grades in motor skills tests *Up to 60 m Low Start Running*, *Handstand Against a Vertical Surface*, *High Jump Scissors Technique*, and *Over-Shoulder Forward Fall to the Dominant Side* also had lower values in measures of subcutaneous adipose tissue and of body voluminosity as well, and vice versa. Slightly lower, but also negative correlation values were shown by the remaining three tests of motor skills, *Basic Floor Shot* (handball), *Bounce from the Middle Position in Volleyball* (volleyball) and *One Hand Shot* (basketball). Redundancy indicators suggested that only 16.51% of the variance of a set of motor skills variables could be estimated with a set of variables of morphological characteristics, and vice versa, a set of variables of motor skills can estimate 21.57% of the variance of a set of variables of morphological characteristics. The obtained data suggested a conclusion that the endomorph body type of the subjects, which proved to be an extremely unfavourable factor, was undoubtedly responsible for a poorer performance of motor skills during this study.

Međutim, da bi adekvatno primijenili motorička znanja u kineziološkoj edukaciji bitno je respektirati i dob s obzirom na to da se ista moraju temeljiti na biološkom stupnju razvoja određenih antropoloških obilježja učenica u pojedinim etapama rasta i razvoja. Samo primjereno motoričko znanje moguće je djelotvorno usvajati, što je preduvjet da ono istodobno poprimi funkciju primjerenog kineziološkog stimulusa u razvoju antropoloških obilježja učenika (Vlahović i Babin, 2018). To je također i preduvjet da određeno motoričko znanje poprimi istodobno i djelovanje primjerenog kineziološkog stimulusa u cilju dostizanja poželjne razine antropoloških obilježja učenica.

Vlahović, Babin, B. i Babin, J. (2016). su istraživali povezanost morfoloških karakteristika i motoričkih znanja reprezentativnih nastavnih tema iz službenog plana i programa Tjelesne i zdravstvene kulture za učenice petih razreda osnovne škole. Tako je na uzorku od 152 učenice u dobi od jedanaest godina primjenjeno šesnaest antropometrijskih mjera za procjenu morfoloških karakteristika i sedam testova reprezentativnih nastavnih tema za procjenu motoričkih znanja. Rezultati kanoničke korelacijske analize, provedene između sustava morfoloških varijabli i varijabli motoričkih znanja učenica, pokazuju da je izdvojen jedan par statistički značajnih kanoničkih faktora s koeficijentom kanoničke korelacije od 0,61 (p=0,00). Struktura relacija izoliranog značajnog para kanoničkog faktora pokazala je da su učenice koje su pokazale bolje ocjene u testovima motoričkih znanja Brzo trčanje do 60 m iz niskog starta, Stoj na rukama uz okomitu plohu, Skok uvis prekoračnom tehnikom „škare" i Pad naprijed preko ramena u dominantnu stranu imale niže vrijednosti u mjerama potkožnog masnog tkiva i voluminoznosti tijela, i obrnuto. Nešto niže, ali također negativne vrijednosti korelacije pokazala su i preostala tri testa motoričkih znanja, Šut s tla osnovnim načinom (rukomet), Vršno odbijanje iz srednjeg odbojkaškog stava (odbojka) i Šut jednom rukom s prsiju iz mjesta (košarka). Pokazatelji redudancije sugeriraju da je skupom varijabli morfoloških karakteristika moguće procijeniti samo 16,51% varijance skupa varijabli motoričkih znanja i obrnuto, da je skupom varijabli motoričkih znanja moguće procijeniti 21,57% varijance skupa varijabli morfoloških karakteristika. Dobiveni podaci upućuju na zaključak da je za lošije izvođenje motoričkih znanja u ovom istraživanju nesumnjivo odgovorna endomorfna tjelesna građa ispitanica, koja se pokazala kao izrazito nepovoljan faktor.

Ovo istraživanje provedeno je s ciljem utvrđivanja povezanosti između varijabli morfoloških karakteristika i testa motoričkog znanja *Stoj na rukama uz okomitu plo-*

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Curren research was conducted with the aim of determining relations between the variables of morphological characteristics and the motor skill test *Handstand Against a Vertical Surface* in primary-school female pupils attending fifth grade. Results of this research will help to understand better the specifications of morphological characteristics in relation to the motor skill *Handstand Against a Vertical Surface* for more efficient planning and programming, as well as monitoring and assessment in Physical Education.

METHODS

The sample of subjects included 152 primary-school female pupils from Split, Republic of Croatia. The subjects were aged 11 (± 6 months), and they were all clinically healthy with no aberrations in behaviour.

Based on previous research (Vlahović et al., 2016; Mišigoj-Duraković, 2008; Mišigoj-Duraković, Matković and Medved, 1995) the measurements were taken by estimating four latent anthropometric dimensions of 16 anthropometric measures, measured by standardized procedures in accordance with the International Biological Survey Programme (IBM) (Weiner and Lourie, 1969). The set included following anthropometric measures:

Longitudinal skeleton dimensionality – 1. *Body height* (AVIS)*; 2. Leg length* (ADŽN)*; 3. Arm length* (ADŽR); *4. Foot length* (ADŽS);

Transversal skeleton dimensionality – *5. Knee diameter* (ADKL); *6. Elbow diameter* (ADLK); *7. Wrist diameter* (ADRZ); *8. Pelvis width* (AŠRZ);

Body volume and mass – *9. Body weight* (ATŽT); *10. Forearm girth* (AOPP); *11. Lower leg girth* (AOPT); *12. Central chest girth* (AOGK);

Subcutaneous fat tissue – *13. Upper arm skinfold* (AKNN); *14. Back skinfold* (AKNL); *15. Belly skinfold* (AKNT); *16. Lower leg skinfold* (AKNP).

Performance the test of the motor skill *Handstand Against a Vertical Surface* (Vlahović, 2012) was assessed by seven independent competent evaluators while directly observing the performance of pupils. Prior to the start of the research, the evaluators were additionally educated on the methods and coordination of the given assessment criteria, and the test was formed according to the following description:

Aids: Three mats, vertical surface (wall), picture of the task.

Performance venue: School gymnasium for Physical Education classes.

Task: The test was to perform a handstand by stepping out with one foot.

hu kod učenica petog razreda osnovne škole. Rezultati ovog istraživanja pomoći će boljem razumijevanju specifikacije morfoloških karakteristika u odnosu na motoričko znanje *Stoj na rukama uz okomitu plohu* za učinkovitije planiranje i programiranje te praćenje i vrednovanje u nastavi Tjelesne i zdravstvene kulture.

METODE

Uzorak ispitanika za potrebe ovog istraživanja sačinjavalo je 152 učenice petih razreda osnovnih škola u Splitu, Republika Hrvatska. Sve ispitanice bile su u dobi od 11 godina (± 6 mjeseci), klinički zdrave i bez aberantnih ponašanja.

Na osnovu dosadašnjih istraživanja (Vlahović i sur., 2016; Mišigoj-Duraković, 2008; Mišigoj-Duraković, Matković i Medved, 1995) mjerenja su izvršena tako da su procijenjene četiri latentne antropometrijske dimenzije od 16 antropometrijskih mjera izmjerenih standardiziranim postupcima koje propisuje Internacionalni biološki program (IBM) (Weiner i Lourie, 1969). Skup je formiran od sljedećih antropometrijskih mjera:

Longitudinalna dimenzionalnost skeleta – 1. *Visina tijela* (AVIS)*; 2. Duljina noge* (ADŽN)*; 3. Duljina ruke* (ADŽR); *4. Duljina stopala* (ADŽS);

Transverzalna dimenzionalnost skeleta – *5. Dijametar koljena* (ADKL); *6. Dijametar lakta* (ADLK); *7. Dijametar ručnoga zgloba* (ADRZ); *8. Širina zdjelice* (AŠRZ);

Volumen i masa tijela – *9. Težina tijela* (ATŽT); *10. Opseg podlaktice* (AOPP); *11.Opseg potkoljenice* (AOPT); *12. Srednji opseg grudnoga koša* (AOGK);

Potkožno masno tkivo – *13. Kožni nabor nadlaktice* (AKNN); *14. Kožni nabor leđa* (AKNL); *15. Kožni nabor trbuha* (AKNT); *16. Kožni nabor potkoljenice* (AKNP).

Izvođenje testa motoričkog znanja *Stoj na rukama uz okomitu plohu* (Vlahović, 2012) vrednovalo je sedam nezavisnih kompetentnih ocjenjivača neposrednim promatranjem izvedbe učenika. Ocjenjivači su prije početka istraživanja bili dodatno educirani o načinu i usuglašavanju zadanih kriterija ocjenjivanja, a test je formiran prema sljedećem opisu:

Pomagala: Tri strunjače, okomita ploha (zid), slika zadatka.

Mjesto izvođenja: Školska dvorana za tjelesnu i zdravstvenu kulturu.

Zadatak: Test je iskorakom jedne noge izvesti stoj na rukama.

Opis i pravilna izvedba testa: Ispitanik se nalazi na udaljenosti od dva koraka (1-1,5 m) od zida/stru-

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Description and correct performance of the test: The subject is positioned two feet (1 – 1.5 m) away from the wall/mat which is set vertically and takes a staggered stance while balancing on the back foot, holding arms straight in line with the ears with palms facing forward. The subject takes a step with the front straight leg. Body weight is shifted to the front leg, the subject bends forward at the waist, keeps the arms in a straight position and places the palms on the ground in the shoulder width position. The palms are positioned at the distance of 50 – 60 cm from the forward leg. Taking an energetic swing with the front straight leg and kicking up from the back leg, the body is lifted in a handstand. While performing handstand, the body is positioned vertically, legs are straightened and gathered, feet are touching the wall/mat, the head is slightly tilted backwards, the view is oriented towards the point of kick-up, the back is in a straight position from the shoulders. The headstand is held for 3 – 4 seconds and after the hold the subject lands back to the ground, by putting down one leg at the time and pushing off with the palms to lift the body from the forward bend back to the standing stance with the arms straight in line with the ears.

Assessment: The subject performs the task once and is assessed on a 1-5 scale (Table 1).

njače postavljene vertikalno te zauzima stav koračni s osloncem na stražnjoj nozi i uzručenjem s dlanovima okrenutim prema naprijed. Izvodi iskorak prednožnom opruženom nogom prema naprijed. Težina tijela prenosi se na iskoračenu nogu, slijedi pretklon trupom prilikom kojeg ispitanik postavlja opružene ruke dlanovima na tlo u širini ramena na udaljenosti 50-60 cm od iskoračene noge. Energičnim zamahom opružene zamašne noge i odgurivanjem od tla odrazne noge tijelo se podiže u stoj na rukama. Prilikom izvođenja stoja na rukama, tijelo se nalazi u okomici, noge su ispružene i skupljene, stopala se dodiruju zida/strunjače, glava je u laganom zaklonu s pogledom usmjerenim u mjesto oslonca, leđa su iz ramena izdužena prema gore. Stoj na rukama zadržava se 3-4 sekunde. Nakon izdržaja stoja na rukama ispitanik se jednom pa drugom nogom spušta na tlo, a istovremeno se odgurava rukama od tla i podiže tijelo iz pretklona do uspravnog stava koračnog s uzručenjem.

Ocjenjivanje: Ispitanik izvodi zadatak jednom i ocjenjuje se ocjenom 1-5 (Tablica 1).

Table 1. *Criteria for assessment of the motor skill Handstand Against a Vertical Surface*

MARK	DESCRIPTION OF THE PERFORMANCE OF THE MOTOR SKILL
5 (excellent)	The subject performs handstand without a mistake
4 (very good)	- insufficiently straightens the body from the shoulders in the handstand position - is insufficiently dynamic while kicking up from the bend (when returning to the finishing position) - the body is not straightened enough both in the initial and finishing position - body not sufficiently straightened while performing the task
3 (good)	- shows insecurity both in the initial and finishing position - lacks in having a dynamic kick off with the kick-off leg - has an incorrect palm position while handstands - slightly bends elbows while handstands - slightly bends the body while handstands - lacks in having a dynamic swing while lifting the body from the bend when returning to the finishing position
2 (sufficient)	- lacks in taking the initial and finishing positions - takes a short step forward ("underneath") - positions hands too close in front of the stepping leg - kicks off with the bent kick-off leg - back too bent while handstands - keeps the head tilted backwards too much while handstands - pushes the shoulders expressively forwards while handstands - lacks in having a dynamic swing while kicking off from the bent position and returning to the finishing position - notably unstable while holding the handstand position - bends elbows while handstands - is too loose while handstands
1 (insufficient)	The subject is not able to perform handstand independently

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Tablica 1. Kriteriji ocjenjivanja motoričkog znanja Stoj na rukama uz okomitu plohu

OCJENA	OPIS IZVOĐENJA TESTA MOTORIČKOG ZNANJA
5 (odličan)	Ispitanik bez pogrešaka izvodi stoj na rukama
4 (vrlo dobar)	- nedovoljno izdužuje tijelo iz ramena u položaj stoja - je nedovoljno dinamičan pri podizanju tijela iz pretklona (kod vraćanja u završni položaj) - nije potpuno pruženog tijela u početnom i završnom položaju - je nedovoljno pruženog tijela prilikom izvođenja zadatka
3 (dobar)	- pokazuje nesigurnost u početnom i završnom položaju - nema dinamičan zamah zamašnom nogom - ima nepravilan položaj dlanova u položaju stoja - manje grči laktove u fazi stoja na rukama - je manje uvijenog tijela u položaju stoja - nema dinamično podizanje tijela iz pretklona prilikom vraćanja u završni položaj
2 (dovoljan)	- nema početni i završni položaj - ima kratak iskorak („pod sebe") - preblizu postavlja ruke ispred iskoračene noge - zamahuje pogrčenom zamašnom nogom - ima veliko uvinuće leđa u položaju stoja na rukama - ima jako zaklonjenu glavu u položaju stoja - izrazito istura ramena prema naprijed u položaju stoja - nema dinamičnosti pri podizanju tijela iz pretklona i vraćanja u završni položaj - vidljivo je nestabilan prilikom zadržavanja stoja - grči laktove u fazi stoja na rukama - je previše opušten „mlohav" kod izvođenja stoja na rukama
1 (nedovoljan)	Ispitanik nije u stanju samostalno izvesti stoj na rukama

The overall results of all measurements of morphological variables and the marks of seven evaluators who assessed the motor skill test were calculated by the use of the Burt's Simple Summation method, i.e. calculating the arithmetic mean of the obtained values, used for the analysis in this study.

In order to get an insight into the relations between the set of morphological variables and the variable of the motor skill *Handstand Against a Vertical Surface*, regression analysis was applied and following was calculated: coefficient of multiple correlation (R), coefficient of determination (R^2), standard error of the estimate (σ_e), F-test value (F), standardized regression coefficient (β), predictor variable linear correlation coefficient (r), t-test value (t) and the significance level (p). Software package Statistics for Windows 13.3 was used for analysis of the obtained data.

Results

Table 2 shows the results of the regression analysis of morphological variables as predictors and the criterion of the variable *Handstand Against a Vertical Surface* in female pupils.

Ukupan rezultat svih mjerenja morfoloških varijabli i ocjena sedmorice sudaca u vrednovanju testa motoričkog znanja izračunavao se Burtovom metodom jednostavne sumacije, tj. izračunavanjem aritmetičke sredine dobivenih vrijednosti te se takvim koristio u analizama ovog istraživanja.

Da bi se dobilo uvid u povezanost između skupa morfoloških varijabli i varijable motoričkog znanja *Stoj na rukama uz okomitu plohu* primijenjena je regresijska analiza te se izračunalo: koeficijent multiple korelacije (R), koeficijent determinacije (R^2), standardnu pogrešku prognoze (σ_e), vrijednost F-testa (F), standardizirani regresijski koeficijent (β), koeficijent linearne korelacije prediktorske varijable (r), vrijednost t-testa (t) i razinu značajnosti (p). Podaci su obrađeni softerskim paketom Statistica for Windows 13.3.

Rezultati

U tablici 2 prikazani su rezultati regresijske analize morfoloških varijabli kao prediktora i kriterijske varijable *Stoj na rukama uz okomitu plohu* kod učenica.

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Table 2. *Regression analysis of the variable Handstand Against a Vertical Surface*

Tablica 2. *Regresijska analiza varijable Stoj na rukama uz okomitu plohu*

R = 0.53	R2 = 0.28	σe = 1.13	F = 3.28	p = 0.00
Variable	β	r	t	p
AVIS	0.14	0.05	0.54	0.59
ADŽN	-0.24	-0.10	-1.13	0.26
ADŽR	-0.07	-0.02	-0.28	0.78
ADŽS	0.08	0.05	0.54	0.59
ADKL	-0.13	-0.07	-0.76	0.45
ADLK	0.25	0.17	1.96	0.05
ADRZ	-0.02	-0.01	-0.13	0.90
AŠRZ	-0.06	-0.03	-0.34	0.73
ATŽT	-0.56	-0.11	-1.27	0.21
AOPP	0.43	0.15	1.79	0.08
AOPT	0.03	0.01	0.11	0.91
AOGK	0.36	0.13	1.56	0.12
AKNN	0.14	0.06	0.68	0.50
AKNL	-0.17	-0.08	-0.97	0.33
AKNT	-0.58	-0.26	-3.17	0.00
AKNP	0.05	0.02	0.27	0.79

Legend: *R – coefficient of multiple correlation; R2 – coefficient of determination; σe – standard error of the estimate; F –F-test value; β – standardized regression coefficient; r – predictor variable linear correlation coefficient; t –t-test value; p – the significance level; AVIS – body height; ADŽN – leg length; ADŽR – arm length; ADŽS – foot length; ADKL – knee diameter; ADKL – elbow diameter; ADRZ – wrist diameter; AŠRZ – pelvis width; ATŽT – body weight; AOPP – forearm girth; AOPT – lower leg girth; AOGK – central chest girth; AKNN – upper arm skinfold; AKNL – back skinfold; AKNT – belly skinfold; AKNP – lower leg skinfold.*

Legenda: *R – koeficijent multiple korelacije; R2 – koeficijent determinacije; σe – standardna pogreška prognoze; F – vrijednost F-testa; β – standardni regresijski koeficijent; r – koeficijent linearne korelacije prediktorske varijable; t – vrijednost t-testa; p – razina značajnosti; AVIS – visina tijela; ADŽN – dužina noge; ADŽR – dužina ruke; ADŽS – dužina stopala; ADKL – dijametar koljena; ADKL – dijametar lakta; ADRZ – dijametar ručnog zgloba; AŠRZ – širina zdjelice; ATŽT – težina tijela; AOPP – opseg podlaktice; AOPT – opseg potkoljenice; AOGK – srednji opseg grudnog koša; AKNN – kožni nabor nadlaktice; AKNL – kožni nabor leđa; AKNT – kožni nabor trbuha; AKNP – kožni nabor potkoljenice.*

The results of the regression analysis (Table 2) indicate a statistically significant relation between the predictor set of morphological variables and the criterion variable *Handstand Against a Vertical Surface*. The coefficient of multiple correlation (R = 0.53) confirmed that a significant part of the variability of the criterion variable can be explained by the impact of the predictor set of variables. The statistical significance of the regression model was confirmed by applying the F-test (F = 3.28; p = 0.00), so the defined regression model can be considered predictively valid. The value of the coefficient of determination (R^2 = 0.28) indicated a statistically significant amount of the common variance of the predictor set and the criterion variable. A high value of the standard error of the estimate (σ_e = 1.13), as an indicator of the standard deviation of scattering of the measured results around the regression line, indicated an unsatisfactory degree of representativeness of the regression model.

Rezultati regresijske analize (Tablica 2) ukazuju na statistički značajnu povezanost prediktorskog skupa morfoloških varijabli s kriterijskom varijablom *Stoj na rukama uz okomitu plohu*. Koeficijent multiple korelacije (R = 0,53) potvrđuje da je značajan dio varijabiliteta kriterijske varijable moguće objasniti utjecajem prediktorskog skupa varijabli. Statistička značajnost regresijskog modela potvrđena je primjenom F-testa (F = 3,28; p = 0,00), pa je definirani regresijski model moguće smatrati prediktivno valjanim. Vrijednost koeficijenta determinacije (R^2 = 0,28) ukazuje na statistički značajnu količinu zajedničke varijance prediktorskog skupa i kriterijske varijable. Visoka vrijednost standardne pogreške prognoze (σ_e = 1,13), kao pokazatelja standardne devijacije raspršenosti izmjerenih rezultata oko pravca regresije, ukazuje na nezadovoljavajući stupanj reprezentativnosti regresijskog modela.

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The analysis of a partial impact of individual variables of the predictor set indicated a statistically significant contribution of the two variables in defining the significance of the regression model. The value of the standardized regression coefficient for the variable *Belly skinfold* (ACNT) (β = -0.58) indicated a significant impact of this variable in defining the value of the criterion variable. The analysed predictor variable showed a statistically significant contribution in defining the value of the criteria (r = -0.26). The obtained results were confirmed by the application of the t-test (t = -3.17; p = 0.00). The variable *Elbow diameter* (ADLK) also had a statistically significant impact on the results of the criterion variable, which confirmed the value of the corresponding standardized regression coefficient (β = 0.25). The observed predictor was correlated with a criterion variable with the coefficient value of 0.17 (r = 0.17). These results were confirmed by the application of the t-test (t = 1.96; p = 0.05).

Discussion and Conclusion

The results of the regression analysis showed a statistically significant correlation between the predictor set of morphological variables and the criterion variable *Handstand Against a Vertical Surface*. The highest correlation was shown by the variable *Belly Skinfold* (ACNT), which had the highest regression coefficient and partial correlation, but with a negative sign, and the variable *Elbow Diameter* (ADLK), which had slightly lower values. This indicates that female pupils with a larger amount of adipose tissue on the belly and smaller values in the elbow diameter got lowest marks, and it is likely that they are generally less kinesiologically active.

Therefore, the study conducted on 152 fifth-grade primary-school female pupils from Split showed that a significant amount of variance of the criterion variable *Handstand Against a Vertical Surface* can be attributed to the impact of the predictor set of morphological variables. The results of the regression analysis in this study showed which are the morphological characteristics and to what extent they are important for efficient performance of the motor skill test *Handstand Against a Vertical Surface* in eleven-year-old female pupils, as well as for the role of this motor skill in transforming individual morphological characteristics for achieving desired final conditions of female pupils in the process of planning and programming in kinesiological education. Also, the results indicated which morphological characteristics should be prioritized in order to achieve better results in the process of monitoring and assessment of pupils while assessing this motor skill, or the teaching content in

Analiza parcijalnog utjecaja pojedinih varijabli prediktorskog skupa, ukazala je na statistički značajan doprinos dviju varijabli u definiranju značajnosti regresijskog modela. Vrijednost standardiziranog regresijskog koeficijenta za varijablu *Kožni nabor trbuha* (AKNT) (β = -0,58) ukazuje na značajan utjecaj navedene varijable u definiranju vrijednosti kriterijske varijable. Analizirana prediktorska varijabla pokazuje statistički značajan doprinos u definiranju vrijednosti kriterija (r = -0,26). Dobiveni nalazi potvrđeni su primjenom t-testa (t = -3,17; p = 0,00). Statistički značajan utjecaj na rezultate kriterijske varijable ostvaruje i varijabla *Dijametar lakta* (ADLK), što potvrđuje vrijednost pripadajućeg standardiziranog regresijskog koeficijenta (β = 0,25). Promatrani prediktor korelacijski je povezan s kriterijskom varijablom s vrijednošću koeficijenta od 0,17 (r = 0,17). Navedeni nalazi potvrđeni su primjenom t-testa (t = 1,96; p = 0,05).

Diskusija i zaključak

Nalazi regresijske analize pokazali su statistički značajnu korelaciju prediktorskog skupa morfoloških varijabli i kriterijske varijable *Stoj na rukama uz okomitu plohu.* Najveću povezanost pokazale su varijable *Kožni nabor trbuha* (AKNT), koji ima najviši regresijski koeficijent i parcijalnu korelaciju, ali s negativnim predznakom te varijabla *Dijametar lakta* (ADLK), koja je nešto nižih vrijednosti. Znači, da su učenice s većom količinom masnog tkiva na trbuhu te manjim vrijednostima dijametra lakta imale i najslabije ocjene te je izgledno da su i općenito kineziološki manje aktivne.

Zaključno, istraživanje koje je provedeno na 152 učenice petih razreda osnovnih škola u Splitu pokazalo je da se značajnu količinu varijance kriterijske varijable *Stoj na rukama uz okomitu plohu* može pripisati utjecaju prediktorskog skupa morfoloških varijabli. Nalazi regresijske analize u ovom istraživanju pokazuju koje su morfološke karakteristike i u kojoj mjeri značajne za efikasno izvođenje testa motoričkog znanja *Stoj na rukama uz okomitu plohu* kod jedanaestogodišnjih učenica, a isto tako i uloge ovog motoričkog znanja u transformaciji pojedinih morfoloških karakteristika za postizanje željenih finalnih stanja učenica u procesu planiranja i programiranja u kineziološkoj edukaciji. Također, nalazi ukazuju na koje morfološke karakteristike prioritetno treba utjecati da bi u procesu praćenja i vrednovanja učenici postizali što bolje rezultate pri ocjenjivanju ovog motoričkog znanja, odnosno nastavnog sadržaja u Tjelesnoj i zdravstvenoj kulturi. Stoga se može zaključiti da programiranje prije početka školske godine, podnošenje planova i pro-

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Physical Education. Therefore, it can be concluded that programming before the beginning of a school year, submitting plans and programmes of Physical Education at the mere beginning of a school year, applying regularities of programming, is simply not possible without initial verification of pupils at the beginning of a school year, and in this case, of their morphological characteristics. This is thus the first prerequisite for the development of a programme, i.e. the beginning of programming in Physical Education in order to get information about current state of anthropological characteristics of pupils.

Besides all previously mentioned, it should be added that programming actually comes down to an exact elaboration of a programme for each pupil individually and it will not be difficult to conclude that it is also a basic prerequisite for individualization of Physical Education classes. Namely, given the fact that programming involves a special, i.e. individual programme for each pupil, this means that in such situation there is not only need for a greater cooperation between pupils and teachers, but also a possibility for achieving a higher form of joint creativity (Findak, 1997). So, all this, as well as the fact that kinesiological science has more and more information about the values of certain kinesiological activities each day, and in this case of the motor skill *Handstand Against a Vertical Surface*, will help to impact the transformation of individual morphological characteristics of female pupils.

After all, it should be noted that this research is a unique attempt to determine the equation of the specification of the motor skill *Handstand Against a Vertical Surface* in kinesiological education and the results of this research cannot be compared to similar research. Therefore, researchers are invited to contribute to this segment, a very important one for kinesiological education, which would address programming as actually one of the basic prerequisites for satisfying authentic needs of female students.

In conclusion, the results of this research are directly applicable in teaching of Physical Education as a basis for understanding the specification models of individual kinesiological structures, and consequently a significant factor in optimizing planning and programming, as well as implementation and evaluation of kinesiological education (Vlahović et al., 2016).

grama tjelesne i zdravstvene kulture na samom početku školske godine, uz primjenu zakonitosti programiranja, jednostavno nije moguće bez inicijalne provjere učenika na početku školske godine. školske godine, au ovom slučaju i njihovih morfoloških karakteristika. To je dakle prvi preduvjet za izradu programa, odnosno početak programiranja tjelesne i zdravstvene kulture kako bi se dobile informacije o trenutnom stanju antropoloških karakteristika učenika.

Uz sve navedeno, treba dodati da se programiranje zapravo svodi na točnu razradu programa za svakog učenika pojedinačno te neće biti teško zaključiti da je ono i temeljni preduvjet za individualizaciju nastave Tjelesne i zdravstvene kulture. Naime, s obzirom na to da programiranje podrazumijeva poseban, odnosno individualni program za svakog učenika, to znači da u takvoj situaciji postoji ne samo potreba za većom suradnjom učenika i nastavnika, već i mogućnost za postizanje većeg oblika zajedničkog stvaralaštva. (Findak, 1997). Dakle, sve ovo, kao i činjenica da kineziološka znanost svakim danom ima sve više informacija o vrijednostima pojedinih kinezioloških aktivnosti, a u ovom slučaju motoričke vještine Stoj na okomitoj podlozi, pomoći će utjecati na transformaciju pojedinca. morfološke karakteristike učenica.

Uostalom, valja napomenuti da je ovo istraživanje jedinstveni pokušaj utvrđivanja jednadžbe specifikacije motoričke vještine Stoj na okomitoj podlozi u kineziološkoj edukaciji te se rezultati ovog istraživanja ne mogu uspoređivati sa sličnim istraživanjima. Stoga su istraživači pozvani da doprinesu ovom segmentu, vrlo važnom za kineziološku edukaciju, koji bi se bavio programiranjem kao zapravo jednim od osnovnih preduvjeta za zadovoljavanje autentičnih potreba studentica.

Rezultati ovog istraživanja direktno su primjenjivi u nastavi Tjelesne i zdravstvene kulture kao osnova razumijevanja specifikacijskih modela pojedinih kinezioloških struktura te posljedično značajan faktor u optimizaciji planiranja i programiranja te provedbe i vrednovanja procesa kineziološke edukacije (Vlahović i sur., 2016).

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