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Relations between Some Anthropometric Characteristics and Fundamental Movement Skills in Eight-Year-Old Children

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Abstract

This study was set to determine the relationship between Body mass index (BMI), percentage of body fat (BF) and fundamental movement skills of eight-year-old children. Seventy-three (36 boys, 37 girls) second grade children were included in the testing. Weight, height, triceps and calf skinfolds were measured for BMI and BF assessment. Two different approach fundamental movement skills tests were administered: "Test of Gross Motor Development-2" (TGMD-2) and fundamental movement skills test (FMS-POLYGON). The correlation between the BMI and the results in two administered tests proved not to be statistically significant. However, significant correlations were found between BF and total TGMD-2 score (r=-0.42; p=0.011) and the total FMS-POLYGON score (r=0.45; p=0.05) only among girls. The most commonly used test for body composition assessment in children – BMI – proved not to be precise enough in relations with FMS. Significant correlation between BMI and fundamental movement skills are expected only in targeted (homogeneous) group of subjects.

Key words*: adipose tissue; body mass index; motor skills; obesity; TGMD-2.*

Introduction

A fundamental movement skill (FMS) is an organized series of basic movements that involves the combination of movement patterns of two or more body segments (Gallahue & Donnelly, 2003). Failure to develop and refine FMS during the crucial preschool and elementary school years often leads children to frustration and failure

during adolescence and adulthood. Children who do not develop mastery of these skills will be unable to successfully and effectively participate in sports in middle school and high school (Payne & Isaacs, 2005). This does not mean that if people do not learn FMS during childhood they cannot develop them later in life, but it is much easier to develop these skills during childhood (Gallahue & Donnelly, 2003). Such deficiency can influence children's social behavior in terms of generating a negative motivation towards physical exercising (Ulrich, 2000). Also, it can influence the increase of overweight and obesity as a negative outcome of physical inactivity (Mendonça & Anjos, 2004). Many researchers used the body mass index (BMI) measure for determining the correlation between morphological characteristics and FMS. It was most commonly used for overweight and obesity classification (Southall et al., 2004; Catenassi et al., 2007; D'Hondt et al., 2009). In general, authors found the negative correlation between the BMI and FMS, primarily in obese children. However, it has to be emphasized that BMI represents a statistical ratio of weight versus height and frequently is not a good indicator of obesity since individuals of the same weight often have different body composition and different proportions of body fat (Sardinha et al., 1999). The results should be carefully seen once the BMI may present a relatively limited discriminatory potential for the identification of obesity cases.

Accordingly, the relation between the BMI and one FMS test does not necessarily have to be similar as the relation with another FMS test. This assumption has been made according to different FMS assessment methods: qualitative and quantitative. The later includes measuring the outcome of the skill performance and it generally ensures a high level of reliability over time and between assessors. Furthermore, most quantitative tests can be done quickly and are capable of testing large groups. As the tester does not require an extensive understanding of movement competencies to administer the test, this approach is useful for generalist teachers or professionals without a background in human movement. In recent years, the most frequently used FMS assessment tools with children employ qualitative measures which focus on the form or technique of the movement, in other words, how the skill is performed. The major advantages of qualitative assessment are that the information can be used to inform the teacher or movement professional which specific components of a skill an individual needs to practice. The negative aspects of qualitative assessment include the difficulty of comparing results that have been gathered by different assessors. To attain information about the quality and quantity of FMS, two FMS tests were used in this research. The tests should provide the necessary information about the FMS process and product.

Since it was suggested for future studies that besides the BMI, skinfold thickness measurements are added in order to obtain more accurate data on the amount of body fat (Catenassi et al., 2007), the main aim of this study was to determine relationships between body mass index (BMI), percentage of body fat (BF) and FMS of eight-year-old boys and girls.

Methods

Seventy-three second graders (36 boys and 37 girls), mean age of 8 years (8.1±0.3) attending elementary schools in Split, Croatia participated in the investigation. Boys averaged 133.2 cm in height and 26.3 kg in weight and had a BMI of 16.5, while girls averaged 134.0 cm in height and 29.7 kg in weight and had a BMI of 16.4. All participants were chosen randomly from a population of 300 children from three schools. They all gave verbal assent and their parents gave written informed consent. The Ethical Committee of the *Faculty of Kinesiology – University of Split* verified that this investigation complied with all ethical standards for scientific investigations involving human participants.

Weight (W) was obtained with use of a digital scale with 0.05 kg precision. Height (H) was measured with an anthropometric tool with 0.1 cm precision, according to prescribed procedures (Gordon et al., 1998). The body mass index (BMI) was determined according to standard procedures ($W(kg)/H^2(m)$). Body fat (BF) measure included a sum of the triceps and calf skinfold and was determined according to the following formulas (Slaughter et al., 1988):

Boys % BF = 0.735 (sum of triceps and calf skinfold) + 1.0

Girls % BF = 0.610 (sum of triceps and calf skinfold) + 5.1

These variables were measured by the same surveyor with John Bull caliper.

To determine the level of the fundamental movement skills (FMS) *"Test of Gross Motor Development"* (TGMD-2) was used. This assessment tool is one of the several tests that measure the qualitative component of the skill. The purpose of the TGMD-2 is to measure the level of FMS in children from age 3 to 10 (Ulrich, 2000). The test is composed of two subtests: loco-motor skills subtest (LOC) and object control skills subtest (OC). Each subtest comprises six skills. The skills that are included in the LOC subtest are: run, gallop, hop, leap, horizontal jump and slide. The six skills that comprise the OC subtest are: striking a stationary ball, stationary dribble, catch, kick, overhand throw and underhand roll. All skills have a set of 3-5 criteria (depending on the test) and every criterion is assessed using a 0 or 1. The child repeats every skill twice, so the maximum score for every skill can be from 6 to 10. The test proved to be valid and reliable on the sample of second-grade children (Catenassi et al., 2007; Niemeijer et al., 2007; Simons et al., 2008; Mazzardo, 2008).

The *FMS-POLYGON* (Žuvela et al., 2011) was the second fundamental movement skills test used in this research (Figure 1). It consisted of 4 tasks: tossing and catching the volleyball against a wall consecutively; running across obstacles; carrying the medicine balls; and straight running. These four tasks cover a range of 4 motor areas: object control, surmounting obstacles, resistance overcoming and space covering skills. The participants' tasks are: to stand on a starting line with the volleyball and begin the first task of tossing and catching a ball against the wall 6 times on the examiner's signal; to leave the ball and run across three obstacles finally passing through the cones; to lift and carry the first and the second medicine ball and put them on the

Swedish vault; to run 20 meters until passing through the photocells. The final result of the test is the time needed to successfully accomplish the four mentioned tasks, but time was also measured for each task separately.

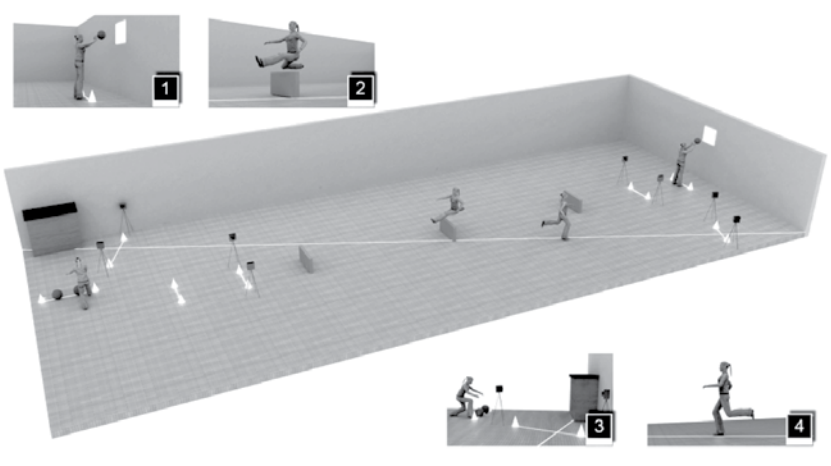

Figure 1. *A 3D sketch of the FMS-POLYGON with separate fragments of the test displayed.*

Data were analyzed using the Statistica for Windows 7.0 package and statistical significance was set at $p \leq 0.05$. Basic descriptive statistics were calculated (mean M, standard deviation SD and Kolmogorov Smirnov test KS). The t-test for independent samples was used to compare genders in weight, height, BMI and BF. The association between the BMI, BF and the fundamental movement skills was analyzed through the Pearson's correlation (r).

Results

According to Kolmogorov Smirnov test for normality of distribution, all variables were normally distributed. Table 1 contains the results of basic statistics for the anthropometric characteristics of the analyzed subjects. Independent samples t-test results did not reveal significant differences for the variables of body height, body weight or BMI between the genders. Significant differences only occurred in the variable of percentage of body fat assessment (BF: t = - 3.58; p = 0.001). By the mean values of BMI and according to defined categories of normal, overweight and obese children (Cole et al., 1974), we can categorize 5 children as obese (6.66%), 8 children as overweight (10.66%) and 60 children as normal (82.68%).

The Pearson's correlation between the BMI and loco-motor (r=-0.02; p=0.882) and manipulative (r=0.04, p=0.733) skills of the TGMD-2 proved not be statistically significant on the total sample (Table 2). However, significant correlations were found between BF and loco-motor (r=-0.27; p=0.001), manipulative (r=-0.37, p=0.001) skills, and total score (r=-0.35; p=0.001) of the TGMD-2. Similar results were found

Table 1. *Basic statistics of anthropometric variables and the results of the independent samples t-test between genders*

VARIABLES	Boys Mean ±SD	Girls Mean ±SD	t test	p
Age	8.06±0.23	8.11±0.23	-0,14	0,884
Body weight (kg)	26.30±5.42	26.70±5.69	0.01	0.999
Body height (cm)	133.15±5.36	134.03±5.37	-0.70	0.458
BMI (kg/m^2)	16.45±2.24	16.44±2.49	-0.30	0.758
BF (%)	14.58±4.68	18.89±5.54	-3.58	0.001

when observing the quantitative gross motor skills test – FMS-POLYGON. Significant correlations between the BMI and the test results were not found, but the correlation was found when analyzing the BF measures. When the general performance in the FMS-POLYGON was correlated with the BF, a statistically significant correlation was found (r=0.29; p=0.014). However, when analyzing each task separately, significant correlations were found for surmounting obstacles (r=0.41; p=0.001) and space covering (r=0.32; p=0.006) skills.

Table 2. *Pearson's correlation coefficients (r) between anthropometric characteristics measures (body mass index - BMI and body fat-BF) and different elements (tasks) of Test of Gross Motor Development (TGMD-2) and FMS-POLYGON (n=73)*

VARIABLES	BMI		BF	
TGMD-2 (points)	*r*	*p*	*r*	*p*
Total score	0.01	0.924	-0.35	0.001
Loco-motor skill	-0.02	0.882	-0.27	0.001
Object control skill	0.04	0.733	-0.37	0.001
FMS-POLYGON (s)				
Total score	0.02	0.892	0.29	0.014
Object control skill	-0.05	0.649	-0.04	0.772
Surmounting obstacles skill	0.13	0.282	0.41	0.001
Resistance overcoming skill	-0.12	0.093	0.07	0.563
Space covering skill	0.03	0.795	0.32	0.006

When the analyses were separately conducted by gender, significant correlations between the BF and two applied gross motor skills tests were found only in girls.

Table 3. *Pearson's correlation coefficients (r) between anthropometric measures (body mass index - BMI and body fat - BF) and different elements (tasks) of Test of Gross Motor Development-2 (TGMD-2) and FMS-POLYGON for boys and girls*

VARIABLES	Boys				Girls			
	BMI		BF		BMI		BF	
TGMD-2 (points)	*r*	*p*	*r*	*p*	*r*	*p*	*r*	*p*
Total score	0.15	0.376	-0.13	0.449	0.14	0.392	-0.42	0.011
Loco-motor skill	0.11	0.522	-0.23	0.101	-0.16	0.322	-0.35	0.001
Object-control skill	0.19	0.266	-0.21	0.145	-0.09	0.571	-0.39	0.001
FMS-POLYGON (s)								
Total score	-0.07	0.675	0.17	0.328	0.13	0.440	0.45	0.005
Object-control skill	0.02	0.905	0.05	0.753	-0.16	0.335	-0.09	0.578
Surmounting obstacles skill	-0.05	0.778	0.21	0.214	0.30	0.070	0.59	0.001
Resistance overcoming skill	-0.25	0.150	-0.04	0.836	-0.15	0.365	0.16	0.354
Space covering skill	-0.18	0.292	0.13	0.461	0.23	0.179	0.43	0.008

Discussion

The results gained do not point to statistically significant correlations between BMI and fundamental movement skills in the total sample, nor in the separate sample of girls and boys. The values of Pearson's correlation coefficients are in accordance with previous study (Catenassi et al., 2007) whose authors claim that the performance of the fundamental movement skills, which can be assessed either qualitatively (Ulrich, 2000) or quantitatively (Kiphard et al., 1974), is not significantly correlated with BMI in 4 to 6-year-old children. Statistically insignificant correlation coefficient between the mentioned variables was found in 9 to 12 (Hume et al., 2008) and 5 to 8-year-old children (Machado et al., 2002). Also, some authors (Nunes et al., 2004) state that body weight, body height and BMI do not significantly affect the performance of locomotor and manipulative motor skills in 6 to 7-year-old children. However, by reviewing another investigation (Wrotniak et al., 2006) that analyzed the issue of relations between the fundamental motor skills measured by the ″Bruininks – Oseretsky Test of Motor Proficiency″ (BOTMP) and the BMI, it can be noticed that overweight and obese children have a lower level of fundamental movement skills performance compared with the normal-weight children. Similar results were gained in previously mentioned investigations (Southall et al., 2004; D'Hondt et al., 2009). The later authors confirmed the existence of a marginal value of the BMI after which the mentioned correlation with the fundamental movement skills becomes significant and negative.

According to these cognitions BMI has a wide application and is a good indicator for overweight and obesity in children. However, by the BMI ″cut-off points″ (Mazzardo, 2008) this research included only 6.66% overweight and 10.66% obese children. So, due to the small sample of overweight and obese children (17.32%), previous conclusions about BMI application seem to be doubtful and represent the main limitation of the research. This is consistent with the research (Catenassi et al., 2007) whose authors also consider the small sample of overweight and obese as research constraint. Unlike these research studies, other researchers (D'Hondt et al., 2009) found significant relations between the BMI and the fundamental movement skills in school children, considering the sample consisted of 18.8% overweight and 29.1% obese children. Analyzing the overweight and obese percentage difference between the research studies, the non-existing relations between the BMI and TGMD-2 in this study are fully expected. To gain more complete images of actual relations between the BMI and the TGMD-2 it is necessary to carry out further research with a larger number of participants and bigger percentage of overweight and obese children. This could lead to more accurate conclusions about the potential for fundamental movement skills development of overweight and obese children.

On the other hand, significant relationships between BF and fundamental movement skills were found in the total sample and in the sample of eight-year-old girls. These results are consistent with the conclusions of previous research (Catenassi et al., 2007). Although TGMD-2 and FMS-POLYGON have assessed different analyses of

movement (qualitative and quantitative), significant correlations were found between both test's performance and BF in girls. Besides the total FMS-POLYGON score, correlation analysis revealed significant relations between BF and only two FMS-POLYGON tasks: running across obstacles and straight running. Since these tasks pertain to space covering and surmounting obstacles skills, it is obvious that children with higher BF experience more problems in mastering space, while fewer problems are expected in object manipulation.

Catenassi et al. (2007) cite that the results about the relations between different fundamental movement skills tests and BMI, which is a common measure of body composition, give only a partial image of actual relations between the morphological characteristics and success in fundamental movement skills tests. This happens because when only BMI is used, the diagnosis of body composition could be mistaken. Such occurrence was the case in current research. Boys and girls showed very similar BMI values, but they statistically differentiated in BF measure. This occurred because some participants presented BMI within ideal standard and BF above the ideal values. The lack of agreement between these indexes explains the fragility of the BMI.

Generally, it is to be expected that significant relations between BMI and FMS occur only in a targeted sample (homogeneous group of subjects) that, according to their body composition, fall in the group of overweight and/or obese. Undoubtedly, BMI as a measure provides an incomplete image of true FMS and BMI relations, especially in heterogeneous groups. For actual and precise body composition determination in children, and its relations with quantitative or qualitative FMS performance, a measure of BF should be included in the research.

Conclusion

Based on the obtained results it may be asserted that the most commonly used test for body composition assessment in children – BMI – proved not to be precise enough in relation with FMS. Pure height to weight ratio clearly does not provide information that is important in children's FMS performance. The fact that BMI testing is easily administrable and inexpensive does not approve its high implementation in scientific research. This mostly refers to research studies with heterogeneous groups of subjects. Furthermore, the fact that girls with higher BF values experience problems in FMS performance, specifically those involving space covering skills, leads to conclusion how serious intervention strategies that decrease BF should be taken in order to enhance better FMS development in girls. This mostly refers to the increase in physical activity. The present study also suggests that physical education programs may need to give additional attention to the FMS development in girls, particularly because of the girls' early dropout from sport in general.

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Povezanost morfološke građe i biotičkih motoričkih znanja u osmogodišnje djece

Sažetak

Istraživanje je provedeno s ciljem utvrđivanja povezanosti između indeksa tjelesne mase (BMI), postotka masnog tkiva (BF) i biotičkih motoričkih znanja (BMZ) u dječaka (N=36) i djevojčica (N=37) prosječne dobi od 8,09 ± 0,25 godina. Kako bi se utvrdila razina usvojenosti biotičkih motoričkih znanja, primijenjen je test za procjenu kvalitete izvedbe BMZ „Test of Gross Motor Development-Second Edition - TGMD-2" i test za procjenu kvantitete izvedbe BMZ „FMS-POLYGON". Rezultati korelacijske analize pokazali su kako ne postoji statistički značajna povezanost između BMI i BMZ. Značajna povezanost dobivena je između BF i BMZ (TGMD-2: r=-0.42; p=0.011; FMS-POLYGON: r=0.45; p=0.05) i to samo kod osmogodišnjih djevojčica. Shodno dobivenim rezultatima može se zaključiti kako BMI pruža ograničene informacije prilikom definiranja povezanosti između morfološke građe i BMZ u odnosu na BF.

Ključne riječi: *indeks tjelesne mase; motorička znanja; potkožno masno tkivo; pretilost; TGMD-2*

Uvod

Biotička motorička znanja (BMZ) organizirani su niz osnovnih pokreta koji uključuju kombinaciju pokreta dvaju ili više dijelova tijela (Gallahue i Donnelly, 2003). Neuspjeh da se navedena motorička znanja usvoje i poboljšaju tijekom ključnih predškolskih i osnovnoškolskih godina često dovodi djecu do frustracija i neuspjeha u sportskim aktivnostima tijekom adolescencije i odrasle dobi (Payne i Isaacs, 2005). Takav nedostatak može utjecati na dječje društveno ponašanje u smislu generiranja negativne motiviranosti prema fizičkim aktivnostima (Ulrich, 2000). Također, to može utjecati na povećanje pretilosti i gojaznosti koje nastaju kao negativan produkt fizičke neaktivnosti (Mendonça i Anjos, 2004). Mnogi istraživači koristili su mjeru indeksa tjelesne mase (BMI) kako bi utvrdili povezanosti između morfoloških karakteristika i BMZ. Općenito, autori su utvrdili negativnu povezanost između BMI i BMZ, prije svega kod pretile i gojazne djece. Međutim, treba naglasiti

da BMI predstavlja omjer tjelesne visine i mase tijela i često nije dobar pokazatelj stvarnog sastava tijela (pretilosti i gojaznosti). Naime, pojedina djeca iste tjelesne mase često imaju različite vrijednosti potkožnog masnog tkiva (Sardinha et al., 1999). Na taj se način može dobiti pogrešna slika o stvarnoj morfološkoj građi, pa tako i o njezinoj povezanosti s motoričkim znanjima. Prema tome, rezultati povezanosti BMI i nekog testa za procjenu BMZ ne moraju biti nužno slični povezanosti BMI s drugim motoričkim testom. Ta pretpostavka proizlazi iz same podjele testova za procjenu motoričkih znanja koja može biti usmjerena na procjenu procesa izvedbe (kvalitativni testovi) i produkta izvedbe (kvantitativni testovi). Kvantiteta izvedbe uključuje procjenu ishoda izvedbe i općenito osigurava visoku razinu pouzdanosti. Nadalje, većina kvantitativnih testova se može brzo izvesti i podobni su za mjerenje velike grupe. Budući da se od mjeritelja ne zahtijeva preširoko razumijevanje i poznavanje izvedbe motoričkih znanja, taj je pristup primjeren kineziolozima koji nisu dovoljno educirani za procjenu izvedbe. Posljednjih su nekoliko godina najčešće korišteni mjerni instrumenti za procjenu BMZ djece kvalitativni testovi koji se fokusiraju na procjenu tehnike izvedbe, drugim riječima, kako se znanje izvodi. Najveće prednosti kvalitativne procjene su informacije koje mogu poslužiti učitelju ili treneru kako bi znao koje komponente znanja dijete treba vježbati. Negativan aspekt kvalitativne procjene uključuje poteškoću uspoređivanja rezultata koji su prikupljeni od različitih procjenitelja. Kako bi se dobile informacije o kvaliteti i kvantiteti izvedbe, u ovom istraživanju korištena su oba pristupa. Shodno dosadašnjim spoznajama koja predlažu da se, osim BMI, primijeni mjera za procjenu potkožnog masnog tkiva (Catenassi i sur., 2007), glavni cilj ovog istraživanja je utvrditi povezanost između indeksa tjelesne mase (BMI), postotka masnog tkiva (BF) i testova za procjenu kvalitete i kvantitete izvedbe BMZ u osmogodišnjih dječaka i djevojčica.

Metode

Istraživanje je provedeno na uzorku od 73 djece (36 dječaka i 37 djevojčica) polaznika drugog razreda osnovne škole u Splitu - Hrvatska. Prosječna vrijednost tjelesne mase dječaka iznosila je 26.3 kg, tjelesne visine 133.2 cm i indeksa tjelesne mase 16.5. Djevojčice su u prosjeku bile visoke 134.03 cm, masa tijela iznosila je 29.70 kg i indeks tjelesne mase 16.44. Jedini kriterij prilikom selekcije učenika bio je da su klinički zdravi i bez aberativnih pojava. Prije samog početka eksperimenta održan je sastanak na kojem su roditelji bili upoznati s ciljevima i osnovama samog istraživanja.

Tjelesna masa ispitanika utvrđena je digitalnom mjerom s 0,05 kg preciznosti. Visina tijela utvrđena je antropometrijskim priborom s preciznošću od 0,1 cm, u skladu s uputama Gordon i sur., (1998). Indeks tjelesne mase „*Body mass indeks*" (BMI) izračunat je tako da se tjelesna masa ispitanika u kilogramima podijelila s kvadratom visine u metrima ($BMI = kg / m^2$).

Postotak masnog tkiva (BF) utvrđen je primjenom sljedeće formule (Slaughter i sur., 1988):

Dječaci % BF = 0.735 (suma kožnih nabora na tricepsu i potkoljenici) + 1.0
Djevojčice % BF = 0.610 (suma kožnih nabora na tricepsu i potkoljenici) + 5.1

Prethodno navedene antropometrijske mjere izmjerio je jedan mjeritelj s pomoću kalipera John Bull.

Kako bi se utvrdila kvaliteta izvedbe biotičkih motoričkih znanja (BMZ), primijenjen je test *"Test of Gross Motor Development"* (TGMD-2). Test „TGMD-2" procjenjuje biotička motorička znanja djece u dobi od 3 do 10 godina na osnovi kriterija. To je jedan od nekolicine testova koji procjenjuju kvalitativne komponente biotičkih motoričkih znanja koje se temelje na normativnoj komponenti. Test TGMD-2 sadrži ukupno 12 motoričkih testova. Svako od tih motoričkih znanja raščlanjeno na tri do pet komponenti. Ispitivač analizira biotička motorička znanja u testu kako bi odredio je li komponenta prisutna (1) ili nije prisutna (0). Test TGMD-2 je konstruiran od podtesta za procjenu lokomotornih znanja (trčanje, galop, preskakanje, bočno kretanje, horizontalni skok i skokovi na jednoj nozi) i podtesta za procjenu manipulativnih znanja (udaranja lopte bejzbolskom palicom, stacionarnog vođenja košarkaške lopte, hvatanja lopte, udaranja lopte nogom, bacanja loptice i kotrljanja lopte). Na temelju rezultata dosadašnjih istraživanja (Catenassi i sur., 2007; Niemeijer i sur., 2007; Simons i sur., 2008; Mazzardo, 2008) može se tvrditi kako TGMD-2 test ima zadovoljavajuće metrijske karakteristike.

Za procjenu kvantiteta izvedbe primijenjen je FMS-Polygon (Žuvela i sur., 2011). Mjerni instrument konstruiran je od sljedećih testova: bacanje i hvatanje odbojkaške lopte o zid, pretrčavanje preko prepreka, dizanje i nošenje predmeta i pravocrtno trčanje. Prethodno navedeni testovi konstruirani su s ciljem da procjenjuju četiri područja biotičkih motoričkih znanja, i to: prostor znanja manipulacije objektima, znanja svladavanja prepreka, otpora i prostora. *Zadatak ispitanika je da stane na startnu liniju s odbojkaškom loptom u rukama. Na znak mjeritelja ispitanik šest puta bacanjem i hvatanjem odbojkaške lopte (a da lopta ne dotakne podlogu) mora pogoditi kvadrat koji je postavljen 150 cm od tla; nakon šestog hvatanja ispitanik ostavlja loptu i znanjem svladavanja prepreka pretrčava tri prepone koje su međusobno udaljene 5 metara. Nakon što prođe kroz čunjeve koji su udaljeni 2 metra od zadnje prepone, ispitanik svladava prostor od 3 metra nošenjem medicinke od 3 kg i podizanjem na švedski sanduk; nakon što podigne drugu medicinku, ispitanik svladava prostor od 20 metara pravocrtnim trčanjem.*

Slika 1.

Nakon provedenog mjerenja, dobiveni podaci uneseni su u program Statistica for "Windows Ver. 7.0". Analizirani su osnovni statistički parametri (aritmetička sredina, standardna devijacija i Kolmogorov Smirnov test normaliteta distribucije). T-testom za nezavisne uzorke utvrđene su razlike između dječaka i djevojčica u masi tijela, visini tijela, BMI i BF. Za utvrđivanje povezanosti između morfološke građe (BMI i BF) i biotičkih motoričkih znanja (TGMD-2 i FMS-POLYGON) primijenjena je klasična korelacijska analiza.

Rezultati

Prema rezultatima Kolmogorov Smirnov testa normaliteta distrubucije, sve varijable ne odstupaju značajno od normalne distribucije. Primjenom T-testa za nezavisne uzorke nisu identificirane značajne razlike između dječaka i djevojčica u tjelesnoj visini, masi tijela i BMI. Statistički značajne razlike utvrđene su samo u postotku masnog tkiva (BF). Na temelju rezultata Cole i sur. (2000), koji su definirali prijelazne točke između normalne, pretile i gojazne djece, pet ispitanika može se svrstati u gojazne (6,66%), osmero u pretile (10,66%), šezdeset ispitanika u one s normalnom tjelesnom građom (82.68%).

Tablica 1.

Rezultati korelacijske analize ukazali su na to kako ne postoji statistički značajna povezanost između BMI i lokomotornih i manipulativnih znanja u ukupnom uzorku ispitanika. Značajna povezanost dobivena je jedino između varijable za procjenu BF i lokomotornih znanja, manipulativnih znanja i ukupnih BMZ. Slični rezultati dobiveni su prilikom utvrđivanja povezanosti između odabranih morfoloških karakteristika i rezultata u FMS-POLYGON. Značajna povezanost dobivena je između BF i ukupnog rezultata u FMS-POLYGON, te između BF i znanja svladavanja prepreka i svladavanja prostora. Promatrajući dobivene rezultate posebno za dječake i djevojčice, statistički značajna povezanost utvrđena je između BF i lokomotornih znanja, manipulativnih znanja, ukupnog TGMD-2 rezultata, znanja svladavanja prepreka u FMS-POLYGONU, svladavanja prostora i ukupnog rezultata u FMS-POLYGONU i to samo kod djevojčica.

Tablica 2. i 3.

Rasprava

Dobiveni rezultati pokazuju da ne postoji statistički značajna povezanost između BMI i biotičkih motoričkih znanja u ukupnom uzorku ispitanika, te da ne egzistira ni spolna determiniranost u odnosima ta dva antropološka obilježja u osmogodišnje djece. Dobivene vrijednosti koeficijenata korelacije u skladu su s rezultatima dosadašnjih istraživanja (Catenassi i sur., 2007), koji su također potvrdili kako realizacija biotičkih motoričkih znanja, koje se može procijeniti kvalitativno (Ulrich, 2000) ili kvantitativno (Kiphard i sur., 1974), nije značajno povezano s BMI u djece u dobi od četiri do šest godina. Slične vrijednosti dobivene su i u djece u dobi od 5 do 8 godina (Machado i sur. 2002), kao i u one u dobi od 9 do 12 godina (Hume i sur. 2008). U prilog dobivenim nalazima idu i spoznaje Nunesa i sur., (2004) koji navode da tjelesna masa, visina tijela i BMI ne utječu značajno na izvođenje lokomotornih i manipulativnih motoričkih znanja u djece u dobi od 6 do 7 godina. Međutim, pregledom istraživanja Wrotniak i sur. 2006, u kojem je analizirana problematika povezanosti BMI i biotičkih motoričkih znanja u „BOT" testu (Bruininks, 1978), vidljivo je kako pretila i gojazna djeca (prema: Cole i sur., 2000) u usporedbi s djecom normalne tjelesne građe imaju

lošiju učinkovitost u izvedbi biotičkih motoričkih znanja. Slični rezultati dobiveni su i u drugim istraživanjima (npr. Southall i sur., 2004; D'Hondt i sur., 2009). Dakle, već je prije utvrđeno postojanje granične vrijednosti BMI nakon koje spomenuta povezanost s biotičkim motoričkim znanjima postaje značajna i negativna. Prema navedenim spoznajama BMI ima široku primjenu, dobar je pokazatelj gojaznosti i pretilosti djece. Međutim, s pomoću "graničnih vrijednosti" indeksa tjelesne mase ovo je istraživanje uključivalo samo 6,66% gojazne djece i 10,66% pretile djece. S obzirom na mali uzorak pretile i gojazne djece (17,32%), prethodni zaključci o primjeni BMI čine se sporni i predstavljaju glavna ograničenja ovog istraživanja. Nasuprot izloženim spoznajama stoje prezentirani rezultati D'Hondta i sur. (2009) koji ističu uvjetovanost izvedbu biotičkih motoričkih znanja indeksom tjelesne mase u djece mlađe školske dobi, s tim da je od ukupnog uzorka ispitanika čak 18.8% djece bilo pretilo i 29.1% gojazno. Pregledom razlike postotka, ponajprije gojazne djece od ukupnog uzorka ispitanika, dobiveni rezultati, koji ukazuju na nepostojanje značajne predikcije BMI na rezultat u primijenjenim motoričkim testovima u ovom istraživanju, sasvim su očekivani. Prema tome, kako bismo dobili potpuniju sliku stvarne povezanosti BMI i uspjeha u TGMD-2 testu i FMS-POLYGONU, potrebna su nova istraživanja koja će uključiti veći uzorak ispitanika i promatrati veći broj gojazne i pretile djece. Tada bi se moglo s većom sigurnošću zaključiti imaju li gojazna i pretila djeca isti potencijal za razvijanje biotičkih motoričkih znanja, i jesu li sposobni jednako izvoditi navedene kretne strukture istom kvalitetom kao djeca s normalnom tjelesnom građom.

S druge strane, značajna povezanost između BF i biotičkih motoričkih znanja dobivena su kod ukupnog uzorka, te kod uzorka osmogodišnjih djevojčica. Ti rezultati u skladu su sa zaključcima prethodnog istraživanja (Catenassi i sur., 2007). Iako su TGMD-2 i FMS-POLYGON usmjereni na procjenu različitih manifestacija biotičkih motoričkih znanja (kvalitativne i kvantitativne), statistički značajna povezanost utvrđena je samo kod djevojčica. Osim kod ukupnog rezultata u FMS-POLYGON, korelacijska analiza potvrdila je značajnu povezanost između BF i dva podtesta (trčanje preko prepreka i pravocrtno trčanje) u primijenjenom poligonu (FMS-POLYGON). Autori Catenassi i sur. (2007) navode da rezultati povezanosti između različitih testova za procjenu biotičkih motoričkih znanja i BMI, što je uobičajena mjera za procjenu sastava tijela, daju samo djelomičnu sliku stvarne povezanosti između morfoloških karakteristika i uspjeha u različitim testovima za procjenu biotičkih motoričkih znanja. Općenito, može se očekivati da se značajna povezanost između BMI i FMS dobije samo u ciljanom uzorku ispitanika (homogena skupina) koji, prema svom sastavu tijela, ulaze u skupinu pretile i/ili gojazne djece. Bez sumnje, BMI kao antropometrijska mjera pruža nepotpunu sliku pravog odnosa BMZ i sastava tijela, osobito u heterogenim skupinama. Za stvarno i precizno utvrđivanje sastava tijela djece i njegov odnos s kvantitativnim ili kvalitativnim izvedbama u testovima za procjenu BMZ, u budućim istraživanjima uz BMI svakako treba uključivati i mjeru BFm što su potvrdili i rezultati ovog istraživanja.

Zaključak

Shodno dobivenim rezultatima može se konstatirati kako najčešće korišten test za procjenu morfološke građe djece – BMI – nije dovoljno precizan u odnosu na biotička motorička znanja. Običan omjer visine i težine očito ne pruža dovoljno informacija koje su važne prilikom izvođenja biotičkih motoričkih znanja. Činjenica da je ovaj test lako upotrebljiv i relativno jeftin, ne opravdava njegovo korištenje u znanstvene svrhe. To se najviše odnosi na istraživanja heterogenih grupa. Nadalje, činjenica da djevojčice s većim vrijednostima BF teže izvode zadatke FMS, osobito one koji se odnose na savladavanje prostora, dovodi do zaključka kako su potrebni ozbiljni kineziološki tretmani koji smanjuju BF vrijednosti da bi se pospješio razvoj FMS kod djevojčica. To se najviše odnosi na povećanje kineziološkog aktiviteta. Ovo istraživanje također sugerira kako programi tjelesne i zdravstvene kulture veću pažnju trebaju posvetiti razvoju FMS kod djevojčica, osobito zato što djevojčice posebno rano odustaju od sporta u cjelini.