UDC:796.012.1:159.923.2.072-057.874
DOI: 10.5937/fizkul2002000R

PREDICTORS OF PHYSICAL ACTIVITY IN EARLY ADOLESCENCE: THE CONTRIBUTION OF PHYSICAL FITNESS AND PHYSICAL SELF-CONCEPT

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Abstract

Vast empirical evidence suggests a high significance of physical activity (PA) for health and well-being. Still, researches show a decline of PA in youth worldwide. Early adolescence is a particularly sensitive period because then children adopt healthy habits and build a positive attitude towards PA. Examining the significance and contribution of potential factors to overall PA in early adolescence is of theoretical and practical relevance. Thus, this study aimed to explore the validity of physical fitness and physical self-concept in the prediction of overall PA in early adolescence, taking into account gender and Body Mass Index (BMI). The sample consisted of 417 primary school students (54.9% boys), the average age 13.6 years (*SD*=0.73) who participate in regular physical education classes three times per week, each class 45 minutes. Physical self-concept was measured using the Physical Self-Description Questionnaire (PSDQ). To assess everyday physical activity, we used the Physical Activity Questionnaire for Adolescents (PAQ-A). Anthropometric measurements included the body height and bodyweight of the respondents. Physical fitness, i.e., flexibility, muscular strength (abdominal endurance strength and lower-limb explosive strength), and cardiorespiratory endurance were measured using the EUROFIT test battery. Hierarchical regression analysis showed that physical self-concept predicts 35% of the variance of PA over and above gender and dimensions of physical fitness. Significant predictors of physical activity were dimensions of physical self-concept: Physical Activity, Sports Competence, and Endurance. The interaction of Gender and Self Esteem contributed significantly indicating that higher Self Esteem had a significant role in the level of PA only in male adolescents. The main finding is that physical self-concept plays a crucial role in the prediction of the level of overall PA in which early adolescents will be engaged. The results support findings showing that intervention programs aimed to improve PA should encourage positive physical self-concept of adolescents with appropriate content and procedures.

Keywords: MOTOR ABILITIES / PHYSICAL SELF-PERCEPTION / BODY MASS INDEX / GENDER/ADOLESCENCE

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INTRODUCTION

Physical activity (PA) or "any bodily movement produced by skeletal muscles resulting in energy expenditure" (Caspersen et al., 1985, p. 234) has tremendous importance on health, as well as on physical, psychological, and social well-being (Biddle & Mutrie, 2007; Janssen & LeBlanc, 2010; World Health Organization, 2010; Hamer et al., 2013; Gomes et al., 2015). The increasingly sedentary lifestyle of people worldwide captured the attention of the researchers recently. Physical inactivity contributes to numerous health problems, as the prevalence of overweight and obesity is constantly increasing (Rizzo et al., 2008; Thibault et al., 2010; Ng et al., 2014). Scholars recommend at least 60 minutes of moderate to intense physical activity per day (Janssen & LeBlanc, 2010). Nevertheless, according to available evidence, a large percentage of the youth is insufficiently physically active (Sallis et al., 2000; Riddoch et al., 2004; Collings et al., 2014). In youth, the level of PA is gender-related in favor of males (Crocker et al., 2000; Sallis et al., 2000; Trost et al., 2002; Thibault et al., 2010; Radisavljević-Janić et al., 2012; Collings et al., 2014; Gomes et al., 2015;). Additionally, the level of PA is age-related; it decreases with age (Trost et al., 2002; Thibault et al., 2010; Jekauc et al., 2012; Radisavljević-Janić et al., 2012), and this trend is more noticeable in female adolescents (Sallis et al., 2000; Nader et al., 2008; Whitehead & Biddle, 2008).

Studies report that transitions from childhood to adolescence, and from adolescence to adulthood are particularly sensitive periods, when a significant decline in the level of PA is detected (Aaron et al., 2002; Trost et al., 2002; Zick et al., 2007; Nader et al., 2008). Bearing in mind the relevance of PA for the development and nourishment of a healthy and active lifestyle (Aaron et al., 2002; Hallal et al., 2006), research of the factors contributing to greater participation of youth in PA is warranted.

Physical fitness or "a set of attributes that people have or achieve that relates to the ability to perform physical activity" (Caspersen et al., 1985, p. 129) and PA are positively associated (Okely et al., 2001; Isler et al., 2002; Castelli & Valley, 2007). Certain socio-demographic characteristics, like gender, age, or body mass index (BMI) were found to be correlated to physical fitness. Higher levels of physical fitness were recorded in males compared to female adolescents (Carraro et al., 2010; Ortega et al., 2011; Milanović et al., 2019). Additionally, physical fitness increases with age in males, while in females, the level of physical fitness remains constant throughout the ages (Ortega et al., 2011). Finally, overweight preadolescent children perform less well than normal-weight children in physical fitness measures (Sung et al., 2005).

Physiological and physical changes occurring with puberty, and adolescent's bodily self-perception are amongst relevant factors influencing the involvement of youth in PA (Crocker et al., 2000; McDevitt & Ormrod, 2002; Garn et al., 2016). Physical self-concept, a construct nested within a hierarchical, multidimensional model of self-concept developed by Marsh and associates, is defined as the individual's self-perception in the physical domain (Marsh et al., 1994). Its association with PA and health-related fitness has been empirically verified (Marsh & Redmayne, 1994; Marsh et al., 2006; Craven & Marsh, 2008; Carraro et al., 2010; Mayorga, et al., 2012; Balsalobre et al., 2014; Jekauc et al., 2017).

Marsh et al. (1994) proposed the multidimensional nature of physical self-concept, where some dimensions are related to characteristics of physical fitness, like strength, endurance, flexibility, while others describe physical characteristics, i.e., appearance, health, and body fat (Marsh et al., 1994). In constructing own physical self-concept, physical fitness is considered one of the main sources besides social feedback (Jekauc et al., 2017).

Meta-analytic evidence indicates a significant positive association between physical self-concept and PA in children and adolescents (Babic et al., 2014). This relation is often explained using the reciprocal-effects model (REM) (Marsh & Craven, 2006). The REM proposes that physical self-

concept and PA are positively and reciprocally related, i.e., development of positive physical self-concept leads to higher engagement of youth in PA, which has positive feedback on physical self-concept (Marsh et al., 2006; Trautwein et al., 2008; Jekauc et al., 2017).

Again, gender, age, and BMI were found to moderate the relationship between physical self-concept and PA (Hamer *et al*., 2013; Babic *et al*., 2014; Garn *et al*., 2016). Specifically, boys show higher overall physical self-concept and score higher on several dimension of physical self-concept like global physical, body fat, appearance, sports competence, and strength, compared to girls (Klomsten *et al*., 2004; Lazarević *et al*., 2008; Çaglar, 2009; Carraro *et al*., 2010; Radisavljević Janić *et al*., 2014; Marsh *et al*., 2015). With age, physical self-concept tends to decrease (Klomsten, *et al*., 2004). Additionally, overweight and obesity are inversely related to physical self-concept in adolescents (O'Dea & Abraham, 1999; Marsh *et al*., 2007; Lazarević *et al*., 2011; Morano *et al*., 2011). Moreover, findings suggest larger differences in physical self-concept between normal-weight and over-weight early adolescents in females compared to males (Lazarević *et al*., 2011).

Numerous studies document that in youth, physical fitness and physical self-concept on one side, and PA on the other are positively related (Marsh & Redmayne, 1994; Marsh *et al*., 2006; Craven & Marsh, 2008; Mayorga *et al*., 2012; Babic *et al*., 2014; Jekauc *et al*., 2017). Specific dimensions of physical self-concept were found to mediate the reciprocal relationship between motor abilities (strength, endurance, coordination, and flexibility) and the organized PA of adolescents (Jekauc *et al*., 2017). Still, studies examining direct contributions of both physical fitness and physical self-concept (of all its dimensions), to overall PA in adolescents (i.e., activity in sports clubs, leisure-time, PE, and daily physical activities) are scarce. Importantly, Okely *et al*. (2012) found a low, but positive association between movement skills and organized PA, while nonorganized PA (i.e., PA that does not involve coach, instructor, or a teacher and that is not structured or formal) was not related to the mastery level of movement skills.

The transition from childhood to adolescence is a particularly sensitive period as studies detect a decrease in the level of physical activity (Trost *et al*., 2002; Nader *et al*., 2008) pinpointing the early adolescent period (middle school period) as critical for supporting young people to establish life activity habits (Hill & Hannon, 2008).

Having in mind the relevance of PA for the development and nourishment of a healthy and active lifestyle in early adolescents**, this study aims** to assess the validity of physical fitness and physical self-concept in the prediction of PA, taking into account the effects of covariates like gender and BMI. Besides theoretical implications, new empirical evidence about the relationship between PA, physical fitness, and physical self-concept, may have relevance to intervention programs, specifically their content and methods, in improving physical activity in youth.

METHODS

Sample

The sample consisted of 417 students from two primary schools in the capital of Serbia[1]. The average age of the children was 13.6 years (*SD*= 0.73); 54.9% (N=229) were boys. All students were participating in regular PE classes, three times per week, each class 45 minutes. The classes were held in the school sports hall. The schools were matched in the physical conditions they provide for both indoor and outdoor activities.

Parents' consent and the approval of the school manager were obtained prior to data collection. All students signed informed consent and participated voluntarily in the study. The study

[1] The sample used in this study were collected as part of the larger project and were also used in Lazarević et al. (2011).

was approved by the IRB of the Faculty of Sport and Physical Education, University of Belgrade. All procedures adhered to the principles of the Declaration of Helsinki.

Measures and Instruments

Anthropometric Measurement

Body height was measured using a Seca Stadiometer 208 (Seca Instruments Ltd., Hamburg, Germany). During the measurement, the pupils were barefoot, wearing their PE clothes, and standing in an upright position on a solid surface. The respondents' task was to straighten their back as much as possible, put their feet together, keeping their heads in the Frankfort plane position. The results were read on a scale at the level of the upper side of a triangular slot of a stadiometer headpiece with an accuracy of 0.1 cm.

Bodyweight was measured to the nearest 0.1 kg using the pre-calibrated portable weighing scale (Tanita Inner Scan Model BC-532, Tanita Europe GmbH., Sindelfingen, Germany). The scales were placed on a solid horizontal surface. The pupils were barefoot, wearing their physical education clothing. During the measurement, they were standing in an upright position in the center of the scales, looking straight ahead and remaining motionless until the measurement was completed. The readings were shown on the scales display and read by an examiner.

Body Mass Index (BMI) was calculated by dividing body weight and body height in square meters (kg/m2).

Physical fitness

Evaluation of the health-related physical fitness was done using the EUROFIT test battery (Council of Europe Committee for the Development of Sport 1988). We assessed flexibility, muscular strength (abdominal endurance strength and lower-limb explosive strength), and cardiorespiratory endurance.

Sit and Reach (SAR) was used to assess flexibility. The participant was seated on the floor with both legs fully extended, shoulder-width apart, and feet placed flat against the box. The task was to slowly reach forward (without jerking), sliding the hands across the top of the ruler, and hold the final position for at least two seconds. A reach distance of 15 cm corresponded with the position of the feet against the box. The best record (in cm) in two attempts was retained.

Sit-ups (SU) were used to assess abdominal endurance strength. The participant lied in the supine position on a mat with his/her knees bent at 90 degrees and his/her feet flat on the floor, held down by the examiner. The hands were placed at the back of the head, fingers interlaced. On the mark "Go!" the student had to contact the knees with his/her elbows and return to the starting position as many times as possible in the 30s. The total number of repetitions completed in the 30s was recorded.

Standing Long Jump (SLJ) was used to evaluate lower-limb explosive strength. The participant stood behind the starting line and was instructed to push off vigorously and jump as far as possible. He/she had to land with the feet together and to stay upright. The distance was measured from the take-off line to the point where the back of the heel nearest to the take-off line lands on the floor. A further attempt was allowed if the respondent fell backward or touched the floor with another part of the body. The best record, measured in centimeters, in two attempts was retained.

The 20-m Shuttle run (SR) was used to assess cardiorespiratory endurance. All participants were required to run between two lines 20 m apart with the time indicated with an audio signal. The initial speed of the signal was 8.5 km/h and was increased by 0.5 km/h/min (1 min equal to 1 stage). The test ended when the child stopped running due to fatigue or failed to reach the line before the next signal for two consecutive times. The time of the last completed lap was recorded, in seconds.

Previous research where anthropometric measures were collected on a sample representative for the elementary school pupils in Serbia, showed that test-retest reliability for 7-grade students (average age 13.6 years) was excellent and ranged between .88 (*Sit-ups*) and .97 (*20-m Shuttle-run* and *Standing Long Jump*) (for a detailed overview see Milanović & Radisavljević Janić, 2015).

Physical Self-Description Questionnaire (PSDQ)

Physical Self-Description Questionnaire (PSDQ) was used to assess students' physical self-concept (Marsh et al., 1994). The scale contains 70 items with a joint 6-point Likert-type scale, ranging from 1 (false) to 6 (true). It allows for the calculation of 11 subscales, nine specific dimensions of physical self-concept (Strength, Body Fat, Physical Activity, Endurance, Sport Competence, Coordination, Health, Appearance, and Flexibility), and two general dimensions (General Physical Self-Concept and Self-Esteem). We used the Serbian version of the PSDQ (Lazarević et al., 2011). The internal consistencies (Cronbach's α) of PSDQ sub-scales, in this study, range between .78 (Self-Esteem) and .92 (Sport Competence) (see Table 1) and are in line with previous findings (Schipke & Freund, 2012). Construct validity of PSDQ on the Serbian sample of adolescents was confirmed in earlier studies (e.g., Radisavljević Janić et al., 2014).

Physical Activity Questionnaire for Adolescents

To assess the physical activity (PA) level of students we administered the Physical Activity Questionnaire for Adolescents (PAQ-A) (Kowalski et al., 1997). The PAQ-A is 9 items, self-administered 7-day recall questionnaire designed and validated to assess the participation of adolescents in different physical activities during the school year and is not used for assessment of PA during school breaks. Each item has a joint 5-point Likert type scale. We used the Serbian version of the PAQ-A (Radisavljević-Janić et al., 2012). On item 1 (Spare time activity), the respondents assess the mean of all activities on the scale ranging between 1 („no") to 5 („7 times or more"). On items 2 to 7 (PE, lunch, right after school, evenings, weekends), the scale ranges from 1 (lowest activity response) to 5 (highest activity response). Item 8 is targeting the mean of all days, and the scale ranges from 1 („none") to 5 („very often"). The last item, no. 9, is used to identify whether a student has been prevented from performing normal physical activities for various reasons. The overall PAQ-A score is derived from the first 8 items, while the last item is not included in the overall score. The internal consistency (Cronbach's α) obtained here is .72 and is in line with previously reported data (Aggio et al., 2016; Voss et al., 2017).

Procedure

Measures were collected during regular PE classes in four sessions. The students first provided self-reports on PSDQ and PAQ-A during two PE classes. Then, during the next two PE classes, in the school sports hall, anthropometric measurement and physical fitness were assessed. The measurement was done by the trained research assistants and the first author of this report. Before the beginning of each measurement, students received a detailed explanation and a demonstration. Students were in a suitable sports outfit during measurement.

Analytic Strategy

We report descriptive statistics and psychometric parameters of the measures, and intercorrelations between used measures. Gender differences were explored using a One-way Analysis of variance (ANOVA). Hierarchical regression analysis was used to assess the validity of physical fitness, and physical self-concept in the prediction of PA. In the first block, gender and BMI were introduced. The next block consisted of the tests assessing physical fitness, while in the third

block PSDQ subscales were introduced. In the first three blocks, the Enter method was employed. To investigate the dependency of these relations on the gender of the adolescents, the interaction effects of 'gender' and each of the 15 predictors were introduced in the fourth step of the analysis. This time a stepwise algorithm was used to select only those interaction effects that have the highest incremental value in explaining the variance of PA while preserving all predictors from the previous steps.

RESULTS

Descriptive statistics and results of the Analysis of Variance (ANOVA) are displayed in Table 1. The results on PAQ-A indicated a moderate level (slightly higher than average level) of PA for the total sample, but when observed within gender groups, ANOVA showed a significantly higher level of PA in boys. On all measures of physical fitness, males exhibited a better performance in comparison to females, except on the *Sit and Reach*. On the PSDQ dimensions, significant differences were obtained on Sports Competence, Strength, Endurance (males score higher on all three), and Self-Esteem where females outperformed males.

Table 1. Descriptive statistics and psychometric properties of the scales

	Males (N=229)		Females (N=188)		Total (N=417)		Comparison of the groups		Cronbach's α
Variable	**M**	**SD**	**M**	**SD**	**M**	**SD**	**F (1,416)**	**p**	
BMI	20.40	3.10	20.76	3.33	20.56	3.20	1.33	.250	/
SLJ	176.90	26.98	142.18	23.17	161.25	30.65	193.84	.000	/
SAR	15.93	6.45	22.32	5.72	18.81	6.91	112.23	.000	/
SU	25.72	4.42	20.69	3.76	23.45	4.83	153.22	.000	/
SR	384.40	131.63	283.26	100.47	338.80	128.73	75.08	.000	/
He	4.86	.86	4.86	1.02	4.86	0.94	0.01	n.s.	.79
Co	4.49	1.07	4.44	1.11	4.46	1.09	0.23	n.s.	.83
PA	4.37	1.28	4.03	1.35	4.22	1.32	6.74	n.s.	.84
BF	5.18	1.03	5.10	1.17	5.14	1.10	0.59	n.s.	.88
SC	4.76	1.13	3.98	1.39	4.41	1.31	39.74	.000	.92
GS	5.06	1.03	4.90	1.20	4.99	1.11	2.26	n.s.	.89
Ap	4.83	1.04	4.79	1.04	4.81	1.04	0.15	n.s.	.82
St	4.72	1.05	4.20	1.04	4.48	1.08	25.44	.000	.83
Fl	4.12	1.22	4.24	1.26	4.17	1.24	1.00	n.s.	.87
En	4.37	1.29	3.50	1.30	3.98	1.36	46.31	.000	.90
SE	5.01	0.87	5.20	0.82	5.10	0.85	5.17	.023	.78
PAQ-A	3.21	0.81	2.87	0.71	3.05	0.78	19.82	.000	.72

Note: BMI - Body mass index; SLJ - Standing Long Jump; SAR - Sit and Reach; SU - Sit-ups; SR - 20m - Shuttle run; He - Health; Co - Coordination; PA - Physical Activity; BF - Body Fat; SC - Sports Competence; GS - General Physical Self-concept; Ap - Appearance; St - Strength; Fl - Flexibility; En - Endurance; SE - Self-Esteem; PAQ-A - Physical Activity Questionnaire for Adolescenc.

To estimate the strength of the association between variables, we employed correlation analysis. The results are displayed in Table 2[2]. Gender was negatively related to the PAQ-A suggesting higher engagement of male adolescents in PA. Additionally, the same direction of correlations was obtained for all measures of physical fitness, except for *Sit and Reach* where the correlation was positive. Males tended to score higher on three subscales of PSDQ, i.e., Sports Competence, Strength, and Endurance.

[2]To reduce the chances of obtaining false-positive results (type I errors) when multiple pairwise tests are performed on the same dataset, we employed Bonferroni correction (Armstrong, 2014).

Table 2. Intercorrelations of the measures

	Gender	BMI	SLJ	SAR	SU	SR	He	Co	PA	BF	SC	GS	Ap	St	Fl	En	SE	PAQ-A
BMI	.06	1.00																
SLJ	-.56**	-.20**	1.00															
SAR	.46**	*.16**	-.07	1.00														
SU	-.52**	-.18**	.59**	*-.12**	1.00													
SR	-.39**	-.26**	.56**	-.1	.52**	1.00												
He	.00	.06	*.14**	.03	.01	.06	1.00											
Co	-.02	-.19**	.28**	*.11**	.29**	.28**	.24**	1.00										
PA	*-.13**	*-.13**	.28**	.04	.33**	.32**	*.14**	.56**	1.00									
BF	-.04	-.50**	.23**	-.01	*.14**	*.15**	.23**	.30**	.19**	1.00								
SC	-.30**	*-.17**	.51**	.02	.47**	.47**	.19**	.63**	.56**	.28**	1.00							
GS	-.07	*-.14**	.33**	.08	.26**	.26**	.28**	.62**	.50**	.42**	.66**	1.00						
Ap	-.02	-.04	*.17**	.08	*.11**	*.12**	.20**	.42**	.31**	.42**	.44**	.63**	1.00					
St	-.24**	.06	.43**	.00	.32**	.33**	.22**	.48**	.43**	*.15**	.61**	.53**	.46**	1.00				
Fl	.05	*-.13**	.21**	.21**	*.12**	*.14**	.20**	.71**	.44**	.29**	.48**	.54**	.45**	.46**	1.00			
En	-.32**	-.20**	.48**	-.05	.46**	.55**	.20**	.62**	.59**	.27**	.75**	.56**	.37**	.60**	.51**	1.00		
SE	*.11**	-.03	*.10**	*.14**	.02	.04	.49**	.44**	.33**	.43**	.40**	.57**	.63**	.37**	.40**	.31**	1.00	
PAQ-A	-.21**	-.05	.30**	-.00	.31**	.37**	*.13**	.42**	.65**	*.13**	.56**	.40**	.25**	.41**	.31**	.58**	.21**	1.00

Note: **p=.000; Correlations in italic are not significant after Bonferroni correction. BMI-Body mass index; SLJ-Standing Long Jump; SAR-Sit and reach; SU-Sit-ups; SR - 20m–Shuttle run; He-Health; Co-Coordination; PA-Physical Activity; BF-Body Fat; SC-Sports Competence; GS-General Physical Self-concept; Ap-Appearance; St-Strength; Fl-Flexibility; En-Endurance; SE-Self-esteem; PAQ-A – Physical Activity Questionnaire for Adolescence.

In this study, BMI was not related to the level of PA. Lower BMI was related to higher performance on *Standing Long Jump*, *Sit-ups*, and *Sit and Reach* test. In addition, BMI correlated negatively with Body Fat, Coordination, and Endurance sub-scales of PSDQ. Higher performance on *Standing Long Jump*, *Sit-ups*, and *20-m Shuttle run* was related to higher achievement on almost all subdomains of physical self-concept, while score on *Sit and Reach* test correlated significantly only with the Flexibility domain of the physical self-concept. The level of physical activity was systematically positively related to all domains of physical self-concept.

Hierarchical linear regression analysis (Table 3) showed that all blocks of variables contributed significantly to the prediction of PA. In the first block, BMI and gender were introduced as predictors, and gender significantly predicted 4.7% of the variance of PA. In the second block, four dimensions of physical fitness were introduced. The *Sit and Reach* measure assessing flexibility and *20-m Shuttle run* test assessing cardiorespiratory endurance explained 11.5% of the variance of the criterion. The third block included all 11 dimensions of physical self-concept and they predicted 35% of the variance of PA over and above gender and measures of physical fitness. Amongst physical self-concept dimensions Physical Activity, Sports Competence, and Endurance were contributing to the prediction of PA (Table 4).

Table 3. Hierarchical linear regression - Physical activity as a criterion

Model Summary									
					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.217[a]	.047	.042	.7680	.047	10.183	2	414	.000
2	.403[b]	.162	.150	.7236	.115	14.093	4	410	.000
3	.715[c]	.511	.490	.5605	.349	25.860	11	399	.000
4	.719[d]	.516	.494	.5580	.005	4.505	1	398	.034

Table 4. Hierarchical linear regression: Physical activity as a criterion (Stepwise method)

Model	Beta	t
Step 4 (Stepwise method)		
Gender	-.05	-.852
BMI	.08	1.70
SLJ	-.05	-.86
SAR	.02	.45
SU	-.05	-.98
SR	.08	1.57
He	.03	.65
Co	-.02	-.39
PA	.48**	10.25
BF	.02	.42
SC	.22**	3.40
GS	.01	.25
Ap	.01	.09
St	.01	.16
Fl	-.07	-1.19
En	.19*	3.00
SE	.14	1.17
Gender*SE	-.23*	-2.12

Note: Interaction effects of gender with physical fitness tests and other PSDQ subscales were excluded by the stepwise algorithm for not additionally contributing; BMI - Body mass index; SLJ - Standing Long Jump; SAR - Sit and reach; SU - Sit-ups; SR - 20m – Shuttle run; He - Health; Co - Coordination; PA - Physical Activity; BF - Body Fat; SC – Sports Competence; GS - General Physical Self-Concept; Ap - Appearance; St - Strength; Fl - Flexibility; En - Endurance; SE - Self-Esteem.
* p<0.05; **p<0.01.

Finally, in the final block the interaction of Gender and Self Esteem (Table 4) singled out as a significant contributor, indicating that in male adolescents, higher Self Esteem has an important role for engagement in PA.

DISCUSSION

The study aimed to evaluate the contribution of physical fitness and multidimensional physical self-concept in the prediction of everyday physical activity of early adolescents, taking into account gender and BMI. A growing interest of researchers for these topics can be primarily attributed to the documented high relevance of PA for psychological and physical wellbeing. Available literature shows that physical fitness and the health status of adolescents are considerably boosted by frequent PA. As noted, with increased physical activity, the prevalence of cardiovascular, respiratory, and metabolic conditions decreases, as well as the level of anxiety and depression (Rizzo et al., 2008; Janssen & LeBlanc, 2010). Predictors of PA are worth exploring due to the benefits that PA has on the development of adolescents.

Our findings suggest that early adolescents are moderately physically active and that males report higher levels of PA compared to their female peers. These findings are in line with previously reported (Crocker et al., 2000; Trost et al., 2002; Riddoch et al., 2004; Radisavljević-Janić et al., 2012; Collings et al., 2014; Gomes et al., 2015). In our sample, on all physical fitness measures, males outperform females, except on flexibility where girls are superior. This is also in agreement with previously published data (Carraro et al., 2010; Ortega et al., 2011; Milanović et al., 2019). Girls have higher Self-Esteem while boys exceed on three dimensions of physical self-concept, i.e., Sports Competence, Strength, and Endurance. These results are partially supported by previous evidence showing that boys score higher on the majority of physical self-concept dimensions compared to girls (Klomsten et al., 2004; Lazarević et al., 2008; Çaglar, 2009; Radisavljević Janić et al., 2014; Marsh et

al., 2015). However, findings on gender differences in self-esteem are inconsistent (Kling et al., 1999; Klomsten et al., 2004; Radisavljević Janić et al., 2014) and require further exploration.

We obtained positive correlations between PA and physical fitness (muscular strength and endurance) and between PA and all dimensions of physical self-concept, which is in line with expectations (Marsh & Redmayne, 1994; Okely et al., 2001; Trost et al., 2002; Riddoch et al., 2004; Castelli & Valley, 2007; Babic et al., 2014). The unrelatedness of BMI and PA is supported by some of the previous findings (e.g., Thibault et al., 2010; Gomes et al., 2015), although there are some contrary voices (e.g., Hamer et. al., 2013). These inconsistencies might stem from different assessment methods used in different studies, like self-reports (Thibault et al., 2010; Hamer et al., 2013;) vs. direct measures (Grund et al., 2000), or from the content of PA on which the researchers are focusing, being overall day activity or activity in organized sport (Thibault et al., 2010).

Here, we documented that the most relevant predictor of the level of PA in early adolescence (compared with physical fitness and sociodemographic characteristics like gender and BMI) is physical self-concept, specifically the following dimensions: Physical activity, Sports Competence, and Endurance. These aspects of physical self-concept explain about 35% of the variance in PA, over and above gender, and physical fitness measures like strength and endurance. Therefore, adolescents who report higher engagement in different forms of PA, perceive themselves as more physically active in different ways, more competent in sports, and more endurable. It is possible that higher validity of dimensions of physical self-concept in the prediction of PA compared to physical fitness results from the fact that we have assessed a wide spectrum of adolescents' PA, such as activity during PE classes, recreational activities like walking, recreational running, riding a bicycle, and not only engagement in organized sports in which, for success, physical fitness the above all.

Previous studies note that physical self-concept is an important facilitator of PA (Marsh & Peart, 1988; Marsh & Redmayne, 1994; Marsh et al., 2006; Jekauc et al., 2017). Our findings corroborate the previous evidence, as we showed that physical self-concept dominates the prediction of the overall everyday PA of early adolescents. Importantly, findings revealed that higher self-esteem in boys results in increased physical activity. This might be a consequence of higher engagement of males in PA, and the importance of PA in the self-perception of male adolescents (McDevitt & Ormrod, 2002; Collings et al., 2014).

Limitations and applied implications

Here we would like to acknowledge some limitations of the current study and point to potential future directions. First, the cross-sectional perspective does not allow us to analyze possible causal relationships between measured constructs. Additionally, including several relevant variables from the social domain, like parental support of children's PA, conditions contributing to and opportunities to exercise (Sallis et al., 2000) would certainly increase the comprehensiveness of the proposed model. Furthermore, the comprehensibility of the study would be increased by including other relevant variables from the domain of body self-perception, like physical self-efficacy, social physique anxiety, and motivation for exercise (McAuley & Blissmer, 2000; Sallis et al., 2000; Gomes et al., 2015).

Importantly, our report on the dominant role of physical self-concept over the physical fitness of early adolescents can be used to improve programs aimed to increase the continuous participation and involvement of adolescents in PA. The schools are an appropriate and relevant environment to introduce PA programs via physical education and extracurricular sports activities. These programs should focus both on the improvement of physical fitness and the strengthening of the physical self-concept, due to their interrelatedness and strong links with physical activity. This is in accordance with previously reported recommendations advocating the simultaneous enhancement of physical self-concept and physical fitness (Marsh & Peart, 1988; Marsh & Redmayne, 1994). Intervention

programs should also focus on teaching methods supporting students' positive self-evaluations, which would be age-adequate and targeting students' interests (Trautwein et al., 2008; Schmidt et al., 2013). Some of the teaching methods that can serve the purpose are strengthening children in self-evaluation of their progress; adequate, frequent, and positive feedback of the teacher; nourishment of fear-free atmosphere in the classroom that would enhance social acceptance in the peer group, and giving preference to individualized reference standard over social reference standard in the assessment of students' achievement. As noted, the benefits of physical activity are numerous. Therefore, the implementation of proposed recommendations outweighs additional resource investment.

CONCLUSIONS

The present contribution shows that physical self-concept, compared to other examined variables, plays a crucial role in the prediction of the level of PA in which adolescents will be engaged. Additionally, self-esteem has an important role in predicting the involvement in PA, but only in male adolescents. Female early adolescents are potentially more vulnerable to negative outcomes in adulthood as they report lower levels of physical activity, and lower physical self-concept. As children tend to avoid activities in which they lack confidence, intervention programs in PE lessons and extracurricular sports activities in school, targeting the improvement of PA in youth should incorporate content and methods that encourage a positive physical self-concept, with a special reference to physical and psychological changes occurring with puberty. Enhancement of positive physical self-concept can stimulate adolescents to adopt important behavioral changes leading towards the discontinuation of inactivity cycles and the promotion of a physically active lifestyle.

Acknowledgment:
This research was supported by the Ministry of Education and Science of the Republic of Serbia under the projects: "Effects of applied physical activity on locomotor, metabolic, psychosocial and educational status on the population of Republic of Serbia" (No III47015, "Identification, measurement, and development of the cognitive and emotional competencies important for a Europe-oriented society" No 179018 and "Improving the quality and accessibility of education in modernization processes in Serbia" No III47008).

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