The Investigation of the Relation between Physical Activity and Academic Success

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Abstract

The purpose of the study is to investigate the interaction among Physical Activity Levels (PAL), academic successes, perceived academic competency and Motor Skills (MS) of male and female students at the age of 14-17 in terms of gender variable. The PALs, perceived academic competency and academic successes were determined through International Physical Activity Questionnaire (IPAQ), Academic Competency Scale and General Academic Averages respectively. MS were tested by sit-and-reach flexibility, vertical jump, hand grip strenght and back and leg strength tests. After the data were entered into the SPSS 16,0 program, paired t-test was done in order to determine the difference between genders. Also, the interaction among PAL, academic success, academic competency and MS of male and female students were analysed through Pearson correlation analysis. As a result, it was found out that parameters related to the PAL and strength of male students are higher than those of female ones while female students' academic success levels are better than those of male students. In addition, while no significant relation between academic success and PAL was found, a positive relation was determined the academic success and perceived academic competency of both genders.

Keywords: student, physical activity, academic success, academic competency, motor skills

1. Introduction

Academic achievement refers to the behavioral changes in all program fields except for an individual's psychomotor and emotional development. In a broader sense, it also consists of goals that are determined by cognitive behaviors such as knowledge and skills as well as those determined by non-cognitive behaviors (Gurdal, 2011). Success in education is determined by "academic success", which is obtained through grades, test scores or both (Carter & Good, 1973). Studies in literature have focused on the relation between academic success and sleep quality, internal motivation, test anxiety, parent participation, cognitive affective intelligence, age or personal features. However, recently, the relation between academic success and physical activity has drawn attention and the number of studies on this issue has increased (Institute of Medicine, 2013).

Studies have revealed that physical activity affects the brain structure and functions through several mechanisms. It is ascertained that, as well as increasing blood stream and brain oxygenation by developing cell capillaries, physical activity also causes a rise in the level of neurotrophines, an expansion in neurons, an increase in brain tissue and development of new neuron links (Cotman, Berchtold, & Christie, 2007; Cotman & Berchtold, 2002; Cooke & Bliss, 2006; Van Praag, Gage, & Lombroso, 2002). Studies assert that such physiological changes occurring in brain affect concentration, data processing and memory strategies and coping strategies, thus improving academic success (Cotman & Berchtold, 2002; Trudeau & Shephard, 2008).

Researches state that students with higher PALs have better attention levels, which may affect the learning environment and cognitive development positively (Taras, 2005; Trost, 2007; Shephard, 1997). Despite the information given above, the questions about the relation between academic success and physical activity haven't been clearly answered yet. While it is stated that there is a positive relation between academic success and physical activity (Singh et al., 2012), another similar study based on the same data revealed that academic success is not related to physical activity (Hattie & Clinton, 2012). Relating academic success directly to physical activity may not be considered right because both physical activity and academic success are bound up with socio-economic structure (von Hippel & Lynch, 2014). According to the correlation studies between

physical activity and academic success, physical activity has little or no effect on academic success (Tomporowski, Davis, Miller, & Naglieri, 2008).

The fact that the results of the studies on the relation between physical activity and academic success vary motivated us to do this research. One purpose of the study is to determine the differences in academic success, MS, PAL and academic competency perceptions in terms of gender. The study also aims to find out the interactions among academic performance, academic competency perceptions, MS and PAL.

2. Material and Method

2.1 Study Group

Target population of the study consists of 9th and 10th grade students studying in Anatolian High Schools under Turkish Republic National Ministry of National Education in Nigde. Research samples consist of 1,207 randomly selected voluntary students, 544 of whom are female and 663 of whom are male. The age, height and weight averages of male students are 15,76±0,81, 171,37±7,41 cm and 62,56±11,46 kg respectively while those of the female students are 15,56±0,73, 162,14±6,01 cm and 55,25±8,61 kg.

2.2 Instrument

2.2.1 Physical Activity Scale

In the study, the PALs of students are determined through the "International Physical Activity Questionnaire", which was adapted into Turkish by Ozturk (2005) from the original version developed by Craig (2003). The physical activity was evaluated through short form including the last seven days. The calculation of the total score of the short form consist of the sum of time (minutes) and frequency (days) of walking, moderate level activity and high level activity. The criteria for the evaluation of all the activities was defined as 10 minutes for each activity during every single training period. A score in the form of "MET-minute/week" was obtained by multiplying minute, day and MET (multiples of resting oxygen consumption) values. PALs were classified as physically inactive (<600 MET-min/week), low level of physical activity (600-3000 MET-min/week) and adequate level of physical activity, which is good for health (>3000 MET-min/week) (Craig, 2003; Ozturk, 2005). Translation and validation study of Turkish version for the university students indicated an evidence for construct validity, criterion validity (accelerometer-IPAQ short form) (r=0.30), and test-retest stability (r=0.69) (Ozturk, 2005).

2.2.2 Perceived Academic Competency

"Academic Competency Scale", which is the subscale of "Student Subjective Well-Being Scale" developed to evaluate the students' positive psychological functions at school was used to determine students' academic competencies (Renshaw, Long, & Cook, 2014; Renshaw, 2015). The scale is a four-Likert type (1-Never, 4-Always) consisting of items such as "I am a successful student.", "I get high grades in exams.", etc. The internal consistency coefficient of the Student Subjective Well-Being Scale was found .89 after the validity and reliability tests in Turkish culture. Besides, the Cronbach Alpha value of the Scholastic Aptitude Scale was calculated as .82. Moreover, the results of the confirmatory factor analysis showed that the scale had good adaptive values (Renshaw & Arslan, 2015).

2.2.3 Perceived Academic Success

Turkish Republic Ministry of National Education determines academic achievement through General Academic Achievement, which refers to the point average of all the lessons at the end of the academic year. The academic achievements of the students who participated in the study were determined by their General Academic Achievement scores taken from school administrations.

2.2.4 The Evaluation of Motor Skills

The hand grip strength, back and leg strengths, vertical jump distances and flexibility performances were tested through Takei (Japanese) brand hand dynamometer, Takei (Japanese) brand back-leg dynamometer, Takei (Japanese) brand jump-meter and sit-and-reach flexibility stand respectively.

1) Hand Grip Strength Test

The dynamometer was squeezed firmly twice with one hand so as to hold it with about 30 degrees between arm and body, and the higher score was recorded. Grip Strength Dynamometer T.K.K 5101 Grip D (Japan) was used for this measurement.

2) Sit-and-Reach (Flexibility) Test

The subject sat in front of a plate with 35 cm length, 35 width and 32 cm height. Then, he was asked to push the ruler slowly forward after putting feet exactly on the inner surface of the plate and to keep them for 3 seconds. The test was performed twice and the higher score was recorded.

3) Leg Strength Test

Leg strength of the athletes was measured using leg dynamometer. While the experiments were standing on the dynamometer as slightly bent from the knees, upright and looking straight ahead, dynamometer was adjusted as the bar below the knee and providing arms to be kept straight. The test was performed in a way pushing above from the legs, and the highest value obtained from two trials performed at 30 second intervals was recorded as the maximal leg strength as kg.

4) Dorsi/Dorsa Strength Test

The leg strength of the athletes was measured by Takkei brand dorsa and leg dynamometer. After the athletes placed their feet on the dynamometer platform with their knees stiff, they lifted the dynamometer bar upright as high as possible with their arms stiff, dorsa straight and bodies slightly bent down. This test was applied three times and the maximum value was recorded.

5) Vertical Jump Test

Vertical Jump Panel was used in determining the vertical jump performances of the athletes who participated in the study. The athletes were asked to jump as high as they can. This test was applied three times and the best results were included in the study.

2.3 Statistical Analysis

The data was entered into SPSS 16.0, a paired t-test was done in order to determine the differences between genders. Also, bivariate correlation analysis was used to find out the relation between physical activity levels, perceived academic competencies, academic success and MS of male and female students. The significance level in the study was found 0.001 and 0.005.

3. Findings

Table 1. The independent t-test table revealing PAL, academic success, academic competence and MS according to gender

	Gender	n	$\bar{x}$	s	t	p
Hand Grip Strength	Male	663	31.72	6.71	26.376	.001**
	Female	544	22.75	4.67		
Flexibility	Male	663	18.08	7.31	-5.998	.001**
	Female	544	20.59	7.08		
Vertical jump	Male	663	39.95	10.90	14.876	.001**
	Female	544	31.61	7.98		
Back strengths	Male	663	77.93	21.56	29.307	.001**
	Female	544	46.67	13.69		
Leg strengths	Male	663	79.85	25.89	26.194	.001**
	Female	544	46.68	15.67		
Academic Success	Male	663	58.87	15.89	-7.036	.001**
	Female	544	65.32	15.76		
Academic Competency	Male	663	3.26	0.46	-0.221	.825
	Female	544	3.26	0.45		
Low İntensity PAL	Male	663	3695.78	5440.29	-1.993	.047
	Female	544	3013.78	4280.55		
Middle Intensity PAL	Male	663	813.84	1163.36	-4.938	.001**
	Female	544	463.49	826.02		

High Intensity PAL	Male	663	1677.43	2106.26	-7.797	.001**
	Female	544	717.18	1258.43		
Total PAL	Male	663	6156.25	4511.03	5.110	.001**
	Female	544	4877.65	4087.87		

**p<0.001, *p<0.05

When the differences between the genders were investigated, hand grip strength ($t_{(1207)}$=26.376, p<0.01), vertical jump ($t_{(1207)}$=14.876, p<0.01), back strength ($t_{(1207)}$=29.307, p<0.01), leg strength ($t_{(1207)}$=26.194, p<0.01) were in favor of the male, whereas academic success ($t_{(1207)}$=-7.036, p<0.01), flexibility performance ($t_{(1207)}$=-5.998, p<0.01) were in favor of the female. In terms of academic success, there were no significant differences between the genders.

Besides, total PAL ($t_{(1207)}$=5.110, p<0.01), high intensity PAL ($t_{(1207)}$=-7.797, p<0.01), moderate intensity PAL ($t_{(1207)}$=-4.938, p<0.01), low intensity PAL ($t_{(1207)}$=-1.993, p<0.01)) were all in favor of the male.

Table 2. Bi-variate correlation table revealing relationship between the PAL, academic success, and MS of the female students

		Vertical jump	Flexibility	Hand strength	Back strengths	Leg strengths	Academic success	PAL
Flexibility	r	0.136**						
	p	0.001						
	N	544						
Hand Strength	r	0.117**	0.071					
	P	0.006	0.096					
	N	544						
Back strengths	r	0.259**	0.199**	0.297**				
	p	0.001	0.001	0.001				
	N	544						
Leg strengths	r	0.209**	0.219**	0.303**	0.802**			
	p	0.001	0.001	0.001	0.001			
	N	544						
Academic Success	r	0.087*	-0.051	-0.037	-0.155**	-0.235**		
	p	0.042	0.232	0.386	0.001	0.001		
	N	544						
PAL	r	0.087*	0.000	0.017	0.052	-0.003	0.047	
	p	0.043	0.997	0.687	0.224	0.949	0.274	
	N	544						
Academic Competency	r	0.023	0.116**	0.017	-0.001	-0.016	0.105*	0.009
	p	0.592	0.007	0.693	0.985	0.707	0.014	0.838
	N	544						

**p<0.001, *p<0.05

When Table 2 was investigated, it was determined that there was a positive correlation between academic success and academic competence at (p<0.005) level. It was determined that there was a positive correlation

between PAL and vertical jump at (p<0.005) level, while there was no significant correlation between PAL and other MS. Moreover, there was no a significant correlation between academic success and PAL.

Table 3. Bi-variate correlation table revealing relationship between the PAL, academic success, and MS of the male students

		Vertical jump	Flexibility	Hand strength	Back strengths	Leg strengths	Academic success	PAL
Flexibility	r	0.090*						
	p	0.020						
	N	663						
Hand Strength	r	0.154**	0.227**					
	P	0.001	0.001					
	N	663						
Back strengths	r	0.125**	0.282**	0.520**				
	p	0.001	0.001	0.001				
	N	663						
Leg strengths	r	0.81*	0.287**	0.498**	0.734**			
	p	0.036	0.001	0.001	0.001			
	N	663						
Academic Success	r	0.163**	-0.091*	-0.013	-0.094*	-0.241**		
	p	0.001	0.019	0.735	0.016	0.001		
	N	663						
PAL	r	0.013	0.064	0.103	0.094*	0.022	-0.050	
	p	0.744	0.102	0.008	0.016	0.565	0.201	
	N	663						
Academic Competency	r	-0.006	-0.031	0.005	-0.041	-0.016	0.253**	0.069
	p	0.877	0.430	0.903	0.293	0.687	0.001	0.075
	N	663						

**p<0.001, *p<0.05

When Table 2 was investigated, it was determined that there was a positive correlation between academic success and academic competence at (p<0.001) level, whereas there was no significant correlation between PAL and academic success. It was determined that there was a significant relationship between PAL and back strength, while there was no significant correlation between PAL and MS.

4. Discussion

When Table 1 was examined, it is clear that the male students' hand grip depending on strength, vertical jump, back and leg parameters are higher than those of the female students. When compared with those of the female, the muscle quality of the female having the same physical features is 15-20% lower. Uponentry into adolescence, the female's excessive estrogen hormone secretion causes fat ratio in their metabolism. On the other hand, uponentry into adolescence, the male's excessive testosterone hormone secretion having a strong anabolic effect on the accumulation of protein in muscle and thus enabling the increase in their muscle mass (Gunay, Tamer, & Cicioglu, 2006). On the strength of such knowledge, it may be stated the fact that the male students' having more strength than that of the female students is an expected result. That the female's PAL is higher than the female's is parallel with the other studies in the current literature (Bergier, Kapka-Skrzypczak, Bilinski, Paprzycki, & Wojtyla, 2012; Vašíčková, Groffik, Frömel, Chmelík, & Wasowicz, 2012; Jekauc, Reimers, Wagner, & Woll, 2012). This case can be explained through the fact that the female prefer more active games, whereas the female

prefer less active games played in covered areas. It is evident in the current study that the female students' academic success is higher than that of the male students. There are also several related studies in the literature showing that the female students' academic success is higher than that of the male students (Duckvvorth & Seligman, 2006; Pomerantz, Altermatt, & Saxon, 2002). This case can be explained through the fact that the female can join in such activities as studying as well as their habit of reading a lot more than the male.

When Table 1 and Table 2 were examined, according to students' self-reports, there was no significant correlation between both the female and male students' academic success and PAL. The studies conducted by Daley and Ryan (2000) and Fisher, Juszczak and Friedman (1996) support the findings achieved in the current study and they also mention that there was no significant correlation between both the female and male students' academic success and physical activities. In the studies conducted on students, it was determined that there was a slight correlation between students' academic success and physical activities (Oh et al., 2003; Tremblay, Inman, & Willams, 2000).

Although Coe, Pivarnik, Womack, Reeves, and Malina (2006) did not find a significant correlation between academic success and PAL of the students involving in moderate intensity activities; they found a positive correlation between academic success and PAL of the students involving in high intensity activities. In addition, although Coe et al. (2006) also stated that there was a positive effect of physical activities performed out of school environment on students' academic success, there was no positive effect of physical education courses given at schools on academic success. This case was perceived as the excess of intensity of physical activity above a threshold limit might have a positive effect on academic success Coe et al. (2006). In a similar study, although there was no significant correlation between students' academic success and PAL in students' self-reports, it was determined that there was a significant correlation between their MS (jumping and shuttle run) and academic success (Jaakkola, Hillman, Kalaja, & Liukkonen, 2015).

The fact that there is a significant correlation between PAL and academic success can support the studies conducted by Jaakkola (2015). However, in the current study, it was determined that there was a negative correlation between academic success and MS. As generally known, as age increases, PAL decreases, which can be explained by the fact that students' preference for academic success rather than physical activities could lead to such a result.

With the aim of increasing PAL and enhancing academic success as well as decreasing the level of obesity, the US government spent $37 million on a programme called "Texas Fitness Now", which lasted for 4 years. As a result, it was concluded that although there was an increase in the level of strength and flexibility, there was an increase in the level of academic success (von Hippel & Bradbury, 2015). It can be considered that physical activity is determinative in academic success, yet it is not the major effect regarding determining success (Coe et al., 2006). In the researches related to the current study, they all reveal that the youth with high socio-economic level have higher PALs and they are involved in sports more frequently (Raudsepp & Viira, 2000; Santos, Esculcus, & Mota, 2004). Therefore, the correlation between PAL and academic success can be taken into consideration (Coe et al., 2006). In the current study, the fact that the researchers did not take the socio-economic level of students into account can be seen as a limitation of the study and it has a restrictive factor in terms of making precise comments on the issue.

The fact that physical activities decrease the students' boredom and thus increasing their concentration and self-esteem as well as enhancing in-class behavior has been mentioned in several studies. It is stated that there is a need for the excess of physical activities to threshold limit in order to see such desired effects; besides, high intensity activities have more effects than moderate intensity activities on academic success (Shephard, 1996). It is clearly seen in the current study, the majority of total physical points calculated through both female and male students' self-reports are determined by low and moderate intensity activities (Table 1). When such results are all considered, it can be explained through the fact that, there is no correlation between studtents' academic success and PAL; moreover, they remain below the threshold limit due to the lack of high intensity activities.

As a conclusion, when the currents literature is investigated, there are studies revealing both positive and negative correlation between academic success and PAL. Moreover, the number of studies regarding the comparison of both MS and academic success is low. In the current study these two methods are utilized and it has been found that there is no correlation between academic success and PAL obtained by means of students' self-reports; however, it has achieved a different result in terms of the existence of the negative correlation between students' MS and academic success, which lacks in the current literature.

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