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CONTENTS | İÇINDEKILER

IJSETS

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The Study Approaches as The Predictors of Academic Self-Efficacy and Teacher Efficacy: A Study in Pedagogical Formation Students

Mevlüt Yıldız[1], Ender Şenel[2], Süleyman Can[3]

Abstract

Aim: This study aims to determine study approaches of students taking pedagogical formation from different departments, examine academic and teacher self-efficacy beliefs, find out the role of these factors in academic achievement and compare students in physical education and sport and students in the different field.

Methods: 515 pedagogical formation students studying in the departments of physical education and sport, history, mathematics, graphic, philosophy, painting, music, business, contemporary Turkish dialects, Turkish philology, food and beverage management, biology, nutrition and dietetics, aquaculture, physics, nursing, English philology, hospitality management and sociology participated in this study. Academic self-efficacy scale, developed by Jerusalem and Schwarzer (1981), adapted to Turkish by Yılmaz, Gürçay and Ekinci (2007) was used to determine academic self-efficacy beliefs. Study Process Questionnaire, developed by Biggs, Kember, and Leung (2001) and adapted to Turkish by Yılmaz and Orhan (2011) was used to determine study approaches. Ohio Teacher Self-Efficacy Scale, developed by Tschannen-Moran & Woolfolk-Hoy, adapted to Turkish by Baloğlu and Karadağ (2008), was used to determine teacher self-efficacy beliefs. Collected data was analyzed in SPSS, path analysis in AMOS.

Results: Significant differences were found between genders regarding surface approach (SA) and surface motivation (SM). A significant difference was found between genders regarding academic self-efficacy. A significant difference was found between students according to their general academic averages (GAA) regarding academic self-efficacy (ASE), teacher self-efficacy (TSE) and study approaches (SA). Moreover, positive correlations were found between GAA, deep approach (DA) and TSE while negative correlation was found between surface approach (SA) and TSE, DA, GAA. Students in physical education and sports department reported higher scores than the others regarding surface approach.

Conclusion: The analysis related to hypothesized model showed that study approaches had an impact on general academic average that had a role in increasing academic self-efficacy, correspondingly teacher self-efficacy beliefs increased.

Keywords
Self-Efficacy,
Study Approaches,
Teaching,
Physical Education,

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INTRODUCTION

Learning types and academic beliefs system are defined as factors contributing to academic achievement (Cassidy & Eachus, 2000). The approaches of an individual toward learning, accordingly toward studying, can have impacts on the processes and perceptions related to academic achievement. When looked from the viewpoint of educational research, the most significant contribution to the conceptualization process of the learning and studying approach has been made by Marton and Säljö (1976) who developed the concepts of "deep and surface approaches." While a student adopting deep approach seeks meaning, interests the subject itself, tries to find a connection between ideas, the surface approach is more about memorizing and the fear of failure (Juklová, Doležalová, Vrabcová & Nowosad, 2015). Additionally, Entwistle and Waterson (1985), Ramsden (1988) have conceptualized "strategic approach" which is related to a student's purpose to have the possible high grade. Biggs (1999) stated, "academic students will adopt a deep approach to learning in their major subjects, often despite their teaching, while non-academic students are likely to adopt a deep approach only under the most favorable teaching conditions." The same student can display different approaches in different conditions (Richardson, 2008). According to Richardson (2011), when students' perception of academic environment mediates the conxtectola factors having the impact on the approaches, there should be a relationship between academic context and the study approaches.

In literature, there are some studies explaining the relationship between academic achievement and approaches to learning and studying (Elliot, McGregor & Gable, 1999; Salamonson, Weaver, Chang,

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Koch, Bhathal et al., 2013). Furthermore, there is evidence showing that the approaches to learning and studying affect self-efficacy (Phan, 2007; Phan, 2011; Azzi, Casanova, Dantas & de Medeiros Maciel, 2011). Self-efficacy perception is related to the self-belief of the people for their abilities to establish control over the events affecting their functioning and lives (Bandura, 1994). Self-efficacy judgments are based on four fundamental sources of information including performance mastery experiences, vicarious experiences, verbal persuasion and physiological states (Bandura, 1982, 1989). Influencing self-efficacy judgment of an individual can bring success (Bandura, 1989). There are studies examined self-efficacy beliefs of teacher candidates and teachers in Turkey (Adilogullari and Senel, 2014; Senel, Adilogullari, and Ulucan, 2014). Correspondingly; academic self-efficacy perception must be related to the perceptions and beliefs of the students' abilities related to their academic lives.

The approaches to learning and studying that have the impacts on the students' academic belief systems or predicting these systems, directly and indirectly, play critical roles on the vocational development of the students receiving education in the institutions training teachers. Accordingly, these approaches can affect the students' abilities related to the teaching profession. From this point of view, it is essential to examine the predicting role of the approaches of teacher candidates on teacher efficacy beliefs. This study aims to determine study approaches of students taking pedagogical formation from different departments, examine academic and teacher self-efficacy beliefs, find out the role of these factors in academic achievement and compare students in physical education and sport and students in the different field. Based on the aim of this study, the following hypotheses were proposed

H1= Study approaches directly predict grade point average.

H2= Study approaches directly predict academic self-efficacy.

H3= Academic self-efficacy directly predicts teacher's efficacy.

H4= Study approaches indirectly predict teacher efficacy via GPA.

H5= Study approaches indirectly predict teacher efficacy via academic self-efficacy.

METHOD

Participants

The students consisting the sample group were recruited among the students based on the condition to carry on pedagogical formation courses in 2017-2018 educational season in Mugla.

Table 1. The demographical information and features of the participants

Variables		Frequency	Percent
Gender	Female	318	61.7%
	Male	197	38.3%
Department	History	88	17.1%
	Physical Education	104	20.2%
	Math	8	1.6%
	Graphic	7	1.4%
	Painting	9	1.7%
	Philosophy	5	1.0%
	Music	2	0.4%
	Business	14	2.7%
	Contemporary Turkish Dialects	45	8.7%
	Turkish Language and Literature	63	12.2%
	Food & Beverage	21	4.1%
	Biology	12	2.3%
	Nutrition	1	0.2%
	Aquaculture	2	0.4%
	Physics	4	0.8%
	Nursing	50	9.7%
	English Language and Literature	10	1.9%
	Hospitality Management	28	5.4%
	Sociology	42	8.2%
Academic Year	Sophomore	4	0.8%
	Third year	36	7.0%

	Final year	375	72.8%
	Graduate	100	19.4%
GPA	Between 0-2.00	20	3.9%
	Between 2.01-2.50	148	28.7%
	Between 2.51-3.00	189	36.7%
	Between 3.01-3.50	115	22.3%
	Between 3.51-4.00	43	8.3%
Total		**515**	**100**

$\bar{X}$(Age)=23.65, s.d.=3.21

Data Collection

Ethical Considerations: Participants were informed about the aim and content of the study. The participants were assured of their right to refuse to participate or to withdraw from the study at any time. The participants were assured that their information and scores in the scale would be kept secret. After accepting to complete the survey, the participnts were sent the document including the scales.

Academic Self-Efficacy: Academic Self-Efficacy Scale, developed by Jerusalem and Schwarzer (1981), translated to Turkish by Yılmaz, Gürçay, and Ekinci (2007), was used to measure the students' perception. The scale is one-dimensional and has seven items. Each item scaled between 1 (certainly does not fit) – 4 (entirely fit for me). The internal consistency coefficient and confirmatory factor analysis (CFA) results were shown in table 2. The fit indices of the Academic Self-Efficacy scale showed a good fit (Iacobucci, 2010; Hair, Black, Babin, Anderson & Tatham, 2010; Hu & Bentler, 1999; Jöreskog & Sörbom, 1986; Bentler, 1995; Steiger & Lind, 1980; Kline, 2016).

Table 2. The internal consistency coefficient and CFA results of the academic self-efficacy scale

							Cronbach's Alpha		
Academic Self-Efficacy							0.60		
CFA Fit Indices	**chi²**	**df**	**chi²/df**	**GFI**	**AGFI**	**TLI**	**CFI**	**SRMR**	**RMSEA**
	29.22	10	2.92	0.95	0.98	0.94	0.97	0.03	0.06

The Study Approaches: The study approaches of students were found out by using The Study Process Questionnaire, developed by Biggs, Kember, and Leung (2001), translated into Turkish by Yılmaz and Orhan (2011). The scale has two subscales including surface and deep approaches. The surface approach has two sub-dimensions including Surface Motivation and Surface Strategy. The deep approach also has two sub-dimensions including Deep Motivation and Deep Strategy. The scale had 20 items and scaled between 1(never or only rarely true of me) – 5 (always or almost always true of me). The internal consistency coefficients and confirmatory factor analysis (CFA) results were shown in table 3. The fit indices of The Study Process Questionnaire displayed a good fit (Iacobucci, 2010; Hair et al., 2010; Hu & Bentler, 1999; Jöreskog & Sörbom, 1986; Bentler, 1995; Steiger & Lind, 1980; Kline, 2016).

Table 3. The internal consistency coefficient and CFA results of the study process questionnaire

							Cronbach's Alpha		
Deep Approach							0.75		
Surface Approach							0.74		
CFA Fit Indices	**chi²**	**df**	**chi²/df**	**GFI**	**AGFI**	**TLI**	**CFI**	**SRMR**	**RMSEA**
	387.13	151	2.56	0.90	0.93	0.82	0.86	0.07	0.05

Perceived Teacher Efficacy: Perceived teacher efficacy of students was measured by using Ohio Teacher Efficacy Scale, developed by Tschannen-Moran and Woolfolk-Hoy (2001), adapted to Turkish by Baloğlu and Karadağ (2008). The Turkish form of the scale has five sub-scales including guidance, behavior management, motivation, teaching skill, assessment, and evaluation. The scale has 24 items scaled between 1 and 5. The internal consistency coefficients and confirmatory factor analysis (CFA) results were shown in table 4. The fit indices of Ohio Teacher Efficacy Scale displayed a good fit (Iacobucci, 2010; Hair et al., 2010; Hu & Bentler, 1999; Jöreskog & Sörbom, 1986; Bentler, 1995; Steiger & Lind, 1980; Kline, 2016).

Table 4. The internal consistency coefficient and CFA results of Ohio Teacher Efficacy Scale

							Cronbach's Alpha		
Guidance							0.78		
Behavior management							0.75		
Motivation							0.79		
Teaching skill							0.70		
Assessment and evaluation							0.47		
Total scale							0.93		
CFA Fit Indices	**chi²**	**df**	**chi²/df**	**GFI**	**AGFI**	**TLI**	**CFI**	**SRMR**	**RMSEA**
	554.85	240	2.31	0.89	0.91	0.92	0.93	0.04	0.05

Statistical analysis

The normality of the data was tested with Skewness and Kurtosis. Because the data showed normal distrubiton, parametric tests were used. The analyses for demographic information of the participants were done by using descriptive analysis. Independent *t*-test was used to analyze the differences between genders, departments. Participants reported their grade point average between 0-2.00, 2.01-2.50, 2.51-3.00, 3.01-3.50, and 3.51-4.00. Pearson Correlation test was used to analyze the relationship between GPA, the study approaches, academic self-efficacy and teacher efficacy. The hypothesized models were analyzed in AMOS by using path analysis.

RESULTS

Table 5. Gender differences regarding academic self-efficacy, study approaches, and teacher efficacy

Dimensions	**Subdimensions**	**Female (n=318)**		**Male (n=197)**				
		$\bar{X}$	S.D.	$\bar{X}$	S.D.	t	df	p
Study Approaches	Deep Motivation	3.18	0.68	3.08	0.75	1.658	513	0.098
	Deep Strategy	3.26	0.68	3.28	0.70	-0.317	513	0.752
	Surface Motivation	2.59	0.78	2.86	0.84	-3.707	513	**0.000****
	Surface Strategy	3.06	0.71	3.13	0.72	-1.084	513	0.279
	Deep Approach	3.22	0.61	3.18	0.65	0.754	513	0.451
	Surface Approach	2.82	0.65	2.99	0.69	-2.815	513	**0.005****
Self-Efficacy	Academic Self-Efficacy	2.95	0.49	3.04	0.48	-2.098	513	**0.036***
Teacher Efficacy Beliefs	Guidance	3.82	0.61	3.81	0.70	0.216	513	0.829
	Behavior Management	3.76	0.59	3.80	0.71	-0.568	513	0.570
	Motivation	3.91	0.62	3.88	0.69	0.589	513	0.556
	Teaching Skill	3.71	0.59	3.76	0.69	-0.740	513	0.460
	Assessment & Evaluation	3.70	0.74	3.73	0.79	-0.465	513	0.642

Gender differences regarding academic self-efficacy, study approaches, and teacher efficacy was shown in table 5. It was found that there were statistically significant differences between genders regarding surface approach ($p<0.01$, $t=-2.815$) and surface motivation ($p<0.001$, $t=-3.707$). Male students reported higher scores than females regarding surface approach and surface motivation. A significant difference was found between genders regarding academic self-efficacy in favor of males.

Table 6. Differences between students in physical education and sports (PES) department and those in other departments regarding academic self-efficacy, study approaches, and teacher efficacy

	PES (n=109)		**The others(n=406)**				
	$\bar{X}$	**S.D.**	$\bar{X}$	**S.D.**	t	df	p
Deep Motivation	3.12	0.64	3.15	0.72	0.398	513	0.712
Deep Strategy	3.29	0.59	3.26	0.71	-0.432	513	0.666
Surface Motivation	3.02	0.70	2.60	0.82	-4.875	513	**0.000****
Surface Strategy	3.26	0.61	3.04	0.73	-2.845	513	**0.005****
Deep Approach	3.21	0.54	3.20	0.65	-0.029	513	0.977
Surface Approach	3.14	0.54	2.82	0.69	-4.476	513	**0.000****

Academic Self-Efficacy	3.08	0.49	2.96	0.49	-2.159	513	**0.031***
Guidance	3.78	0.62	3.82	0.65	0.643	513	0.520
Behavior Management	3.77	0.66	3.78	0.64	0.183	513	0.855
Motivation	3.88	0.59	3.91	0.66	0.183	513	0.663
Teaching Skill	3.73	0.67	3.73	0.62	0.436	513	0.955
Assessment & Evaluation	3.64	0.82	3.73	0.74	1.027	513	0.305

The differences between students in physical education and sports department and those in the other departments regarding academic self-efficacy, study approaches, and teacher efficacy were displayed in table 6. Significant differences were found between students studying (or graduated from) in physical education and sports department and those in the other examined departments regarding surface motivation (t=-4.875, p<0.001), surface approach (t=-4.476, p<0.001) and academic self-efficacy (t=-2.159, p<0.05). The students in physical education and sports department reported higher scores than other students.

Table 7. Correlation coefficients, standard deviations, mean scores, and normal distribution values

	n = 515	**$\bar{X}$**	**S.D.**	**Skewness**	**Kurtosis**
1) GPA		3.02	1.00	0.218	-0.548
2) Deep Motivation		3.14	0.71	0.014	-0.016
3) Deep Strategy		3.26	0.69	-0.112	130
4) Surface Motivation		2.69	0.82	0.044	-0.412
5) Surface Strategy		3.08	0.72	-0.177	0.003
6) Deep Approach		3.20	0.63	-0.052	0.351
7) Surface Approach		2.89	0.67	-0.144	-0.118
8) Academic Self-Efficacy		2.99	0.49	-0.233	-0.237
9) Guidance		3.82	0.65	-0.360	0.054
10) Behavior Management		3.78	0.64	-0.211	-0.317
11) Motivation		3.90	0.65	-0.693	1.106
12) Teaching Skill		3.73	0.63	-0.197	-0.033
13) Assessment & Evaluation		3.71	0.76	-0.333	-0.112

	GPA	**DM**	**DS**	**SM**	**SS**	**DA**	**SA**	**ASE**	**GU**	**BM**	**MOT**	**TS**	**AE**
1) GPA	1												
2) DM	0.266**	1											
3) DS	0.211**	0.630**	1										
4) SM	-0.165**	-0.215**	-0.190**	1									
5) SS	-0.039	0.063	0.018	0.542**	1								
6) DA	0.265**	0.905**	0.900**	-0.225**	0.045	1							
7) SA	-0.121**	-0.097*	-0.106*	0.894**	0.860**	-0.112*	1						
8) ASE	0.204**	0.354**	0.299**	-0.045	0.075	0.362**	0.013	1					
9) GU	0.130**	0.277**	0.280**	-0.121**	0.133**	0.308**	-0.003	0.333**	1				
10) BM	0.104*	0.241**	0.248**	-0.091*	0.123**	0.270**	0.010	0.331**	0.808**	1			
11) MOT	0.136**	0.258**	0.249**	-0.105*	0.143**	0.281**	0.012	0.321**	0.816**	0.756**	1		
12) TS	0.082	0.265**	0.271**	-0.043	0.131**	0.297**	0.044	0.333**	0.783**	0.749**	0.709**	1	
13) AE	0.137**	0.238**	0.270**	-0.066	0.072	0.281**	-0.002	0.298**	0.653**	0.606**	0.620**	0.653**	1

*The GPA was codded between 1 (Between 0-2.00), 2 (Between 2.01-2.50), 3 (Between 2.51-3.00), 4 (Between 3.01-3.50), 5 (Between 3.51-4.00), *p<0.05, **p<0.01*

Table 7 displays the correlation coefficients, standard deviations, mean scores, and normal distribution values. GPA positively correlated with deep motivation (r=0.266, p<0.05), deep strategy (r=0.211, p<0.05), deep approach (r=0.265, p<0.05), academic self-efficacy (r=0.204, p<0.05), guidance (r=0.130, p<0.05), behavior management (r=0.104, p<0.05), motivation (r=0.136, p<0.05), assessment & evaluation (r=0.137, p<0.05); it negatively correlated with surface motivation (r=-0.165, p<0.05) and surface approach (r=-0.121, p<0.05). Deep approach positively correlated with academic self-efficacy (r=0.362, p<0.05), guidance (r=0.308, p<0.05), behavior management (r=0.270, p<0.05), motivation (r=0.281, p<0.05), teaching skill (r=0.297, p<0.05), assessment & evaluation (r=0.281, p<0.05). Academic self-efficacy positively correlated with guidance (=0.333, p<0.05), behavior management (r=0.331, p<0.05), motivation (r=0.321, p<0.05), teaching skill (r=0.333, p<0.05), assessment &

evaluation (r=0.298, p<0.05). The correlations between the variables were found to be low according to Taylor (1990).

Figure 1. Deep and surface study approaches as predictors of teacher efficacy and academic self-efficacy (Model 1)

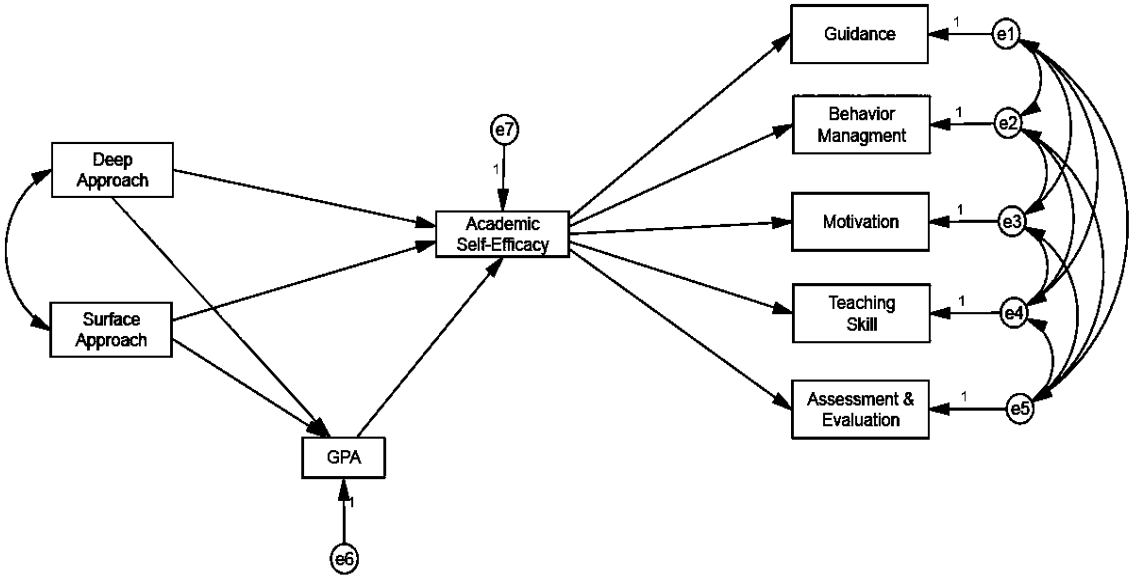
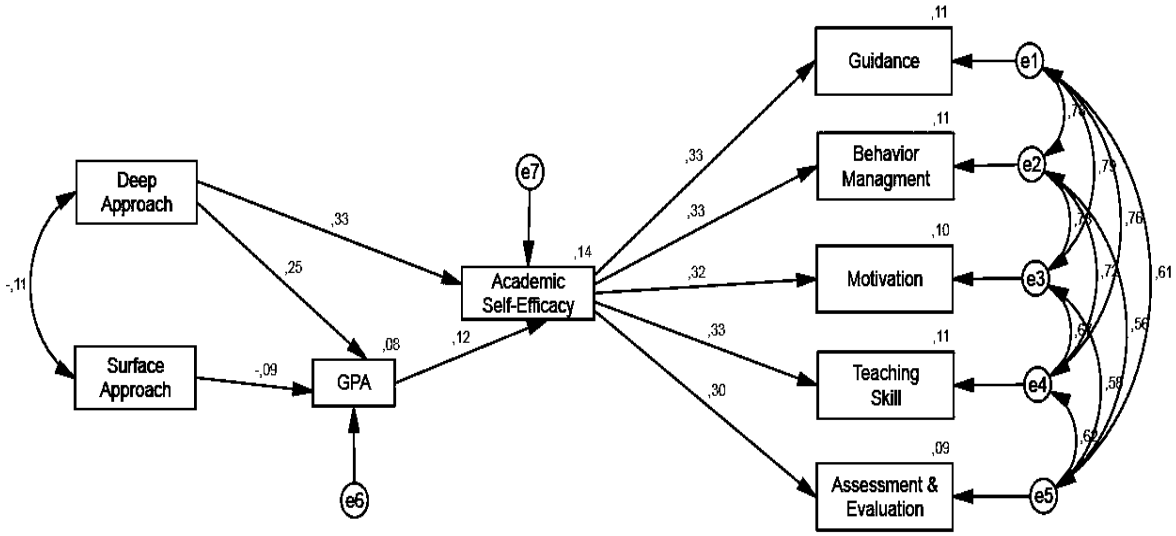


Figure 1 represents the model 1 hypothesizing that deep and surface approaches predict GPA and academic self-efficacy, directly and indirectly, academic self-efficacy via GPA. It is also hypothesized that GPA predicts academic self-efficacy directly and teacher efficacy indirectly via academic self-efficacy. The analysis revealed that the hypothesis that surface approach predicted academic self-efficacy directly was statistically insignificant. This path was removed from the model, and the analysis was calculated again for the new model (model 1.1).

Figure 2. Model 1.1



The regression directions and standardized regression coefficients were displayed in figure 2. Table 8 shows the fit indices and estimations for model 1.1. As it is seen in table 8, the fit indices show that the model has a good fit.

Table 8. The fit indices and estimations for model 1.1

	Mediator/ Modeator		Estimates	Standard Error	C.R.	p	Direct Effect	Indirect Effect
Surface Approach	→	GPA	-0.092	0.063	-2.163	p<0.05	-0.092	-
Deep Approach	→	GPA	0.254	0.067	5.967	p<0.001	0.254	-
Deep Approach	→	Academic Self-Efficacy	0.331	0.033	7.817	p<0.001	0.331	0.030
GPA	→	Academic Self-Efficacy	0.116	0.021	2.749	p<0.01	0.116	-
Academic Self-Efficacy	→	Guidance	0.333	0.055	8.010	p<0.001	0.333	-
Academic Self-Efficacy	→	Behavior Management	0.331	0.054	7.964	p<0.001	0.331	-
Academic Self-Efficacy	→	Motivation	0.321	0.055	7.679	p<0.001	0.321	-
Academic Self-Efficacy	→	Teaching Skill	0.333	0.053	8.013	p<0.001	0.333	-
Academic Self-Efficacy	→	Assessment & Evaluation	0.298	0.065	7.068	p<0.001	0.298	-
Deep Approach	ASE	Guidance	-	-	-	p<0.05	-	0.110
Deep Approach	ASE	Behavior Management	-	-	-	p<0.05	-	0.109
Deep Approach	ASE	Motivation	-	-	-	p<0.05	-	0.106
Deep Approach	ASE	Teaching Skill	-	-	-	p<0.05	-	0.110
Deep Approach	ASE	Assessment & Evaluation	-	-	-	p<0.05	-	0.098
Deep Approach	GPA+ASE	Guidance	-	-	-	p<0.05	-	0.009
Deep Approach	GPA+ASE	Behavior Management	-	-	-	p<0.05	-	0.009
Deep Approach	GPA+ASE	Motivation	-	-	-	p<0.05	-	0.009
Deep Approach	GPA+ASE	Teaching Skill	-	-	-	p<0.05	-	0.009
Deep Approach	GPA+ASE	Assessment & Evaluation	-	-	-	p<0.05		0.008
GPA	→	Guidance	-	-	-	p<0.05	-	0.035
GPA	→	Behavior Management	-	-	-	p<0.05	-	0.039
GPA	→	Motivation	-	-	-	p<0.05	-	0.037
GPA	→	Teaching Skill	-	-	-	p<0.05	-	0.039
GPA	→	Assessment & Evaluation	-	-	-	p<0.05	-	0.039
Surface Approach	→	Academic Self-Efficacy	-	-	-	p<0.05	-	-0.011
Surface Approach	GPA+ASE	Guidance	-	-	-	p<0.05	-	-0.003
Surface Approach	GPA+ASE	Behavior Management	-	-	-	p<0.05	-	-0.004
Surface Approach	GPA+ASE	Motivation	-	-	-	p<0.05	-	-0.003
Surface Approach	GPA+ASE	Teaching Skill	-	-	-	p<0.05	-	-0.004
Surface Approach	GPA+ASE	Assessment & Evaluation	-	-	-	p<0.05	-	-0.004

Fit Indices

Model 1.1	chi^2	df	chi^2/df	GFI	AGFI	TLI	CFI	SRMR	RMSEA
	39.76	16	2.48	0.95	0.98	0.97	0.98	0.06	0.05

While surface approach negatively predicted the GPA by approximately 9% (R^2=-0.092, p<0.05), deep approach positively predicted the GPA by approximately 25% (R^2=0.254, p<0.05). It was found that deep study approach directly predicted academic self-efficacy by about 33% (R^2=0.331, p<0.05), indirectly by almost 3% via the GPA. It was seen that the GPA positively predicted academic self-efficacy by about 12% (R^2=0.116, p<0.05). Academic self-efficacy positively and directly predicted guidance (R^2=0.333, p<0.05), behavior management (R^2=0.331, p<0.05), motivation (R^2=0.321, p<0.05), teaching skill (R^2=0.333, p<0.05), assessment and evaluation (R^2=0.298, p<0.05) by approximately 33%, 33%, 32%, 33%, and 33%, respectively.

Deep approach indirectly and positively predicted guidance, behavior management, motivation, teaching skill, and assessment and evaluation by about 11%, 10%, 10%, 11%, and %9 respectively, via academic self-efficacy. Deep approach indirectly and positively predicted guidance, behavior management, motivation, teaching skill, and assessment & evaluation by about 0.09%, 0.09%, 0.09%, 0.09%, and 0.08%, respectively, via GPA and academic self-efficacy. GPA indirectly and positively predicted guidance, behavior management, motivation, teaching skill, and assessment & evaluation by about 3%, 4%, 4%, 4%, and 4%, respectively, via academic self-efficacy. Surface approach negatively and indirectly predicted academic self-efficacy by about 1% via GPA. Surface approach negatively and indirectly predicted guidance, behavior management, motivation, teaching skill, and assessment & evaluation by about 0.03%, 0.04%, 0.03%, 0.04%, and 0.04%, respectively, via academic self-efficacy and the GPA.

Figure 3. Deep study approach as the predictor of teaching efficacy and academic self-efficacy (Model 2)

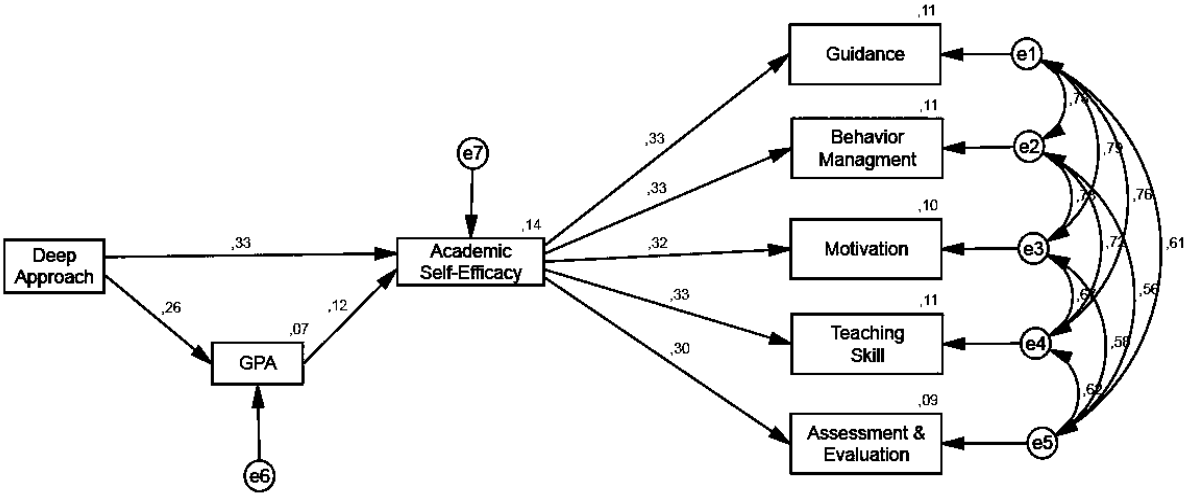


Figure 3 shows the model 2 hypothesizing deep approach predicted both academic self-efficacy and the GPA directly. It was hypothesized that deep approach indirectly predicted academic self-efficacy via GPA and teacher efficacy via GPA and academic self-efficacy. The fit indices and estimations for model 2 were shown in Table 9.

Table 9. The fit indices and estimations for model 2

	Mediator/ Moderator		Estimates	Standard Error	C.R.	p	Direct Effect	Indirect Effect
Deep Approach	→	GPA	0.265	0.067	6.220	p<0.001	0.265	-
Deep Approach	→	Academic Self-Efficacy	0.331	0.033	7.817	p<0.001	0.331	0.031
GPA	→	Academic Self-Efficacy	0.116	0.021	2.749	p<0.01	0.116	-
Academic Self-Efficacy	→	Guidance	0.333	0.055	8.010	p<0.001	0.333	-
Academic Self-Efficacy	→	Behavior Management	0.331	0.054	7.964	p<0.001	0.331	-
Academic Self-Efficacy	→	Motivation	0.321	0.055	7.679	p<0.001	0.321	-
Academic Self-Efficacy	→	Teaching Skill	0.333	0.053	8.013	p<0.001	0.333	-
Academic Self-Efficacy	→	Assessment & Evaluation	0.298	0.065	7.068	p<0.001	0.298	-
Deep Approach	ASE	Guidance	-	-	-	p<0.05	-	0.110
Deep Approach	ASE	Behavior Management	-	-	-	p<0.05	-	0.109
Deep Approach	ASE	Motivation	-	-	-	p<0.05	-	0.106
Deep Approach	ASE	Teaching Skill	-	-	-	p<0.05	-	0.110
Deep Approach	ASE	Assessment & Evaluation	-	-	-	p<0.05	-	0.098
Deep Approach	GPA+ASE	Guidance	-	-	-	p<0.05		0.010
Deep Approach	GPA+ASE	Behavior Management	-	-	-	p<0.05		0.010
Deep Approach	GPA+ASE	Motivation	-	-	-	p<0.05		0.009
Deep Approach	GPA+ASE	Teaching Skill	-	-	-	p<0.05		0.010
Deep Approach	GPA+ASE	Assessment & Evaluation	-	-	-	p<0.05		0.009
GPA	→	Guidance	-	-	-	p<0.05	-	0.035
GPA	→	Behavior Management	-	-	-	p<0.05	-	0.039
GPA	→	Motivation	-	-	-	p<0.05	-	0.037
GPA	→	Teaching Skill	-	-	-	p<0.05	-	0.039
GPA	→	Assessment & Evaluation	-	-	-	p<0.05	-	0.039

Fit Indices

Model 2	chi^2	df	chi^2/df	GFI	AGFI	TLI	CFI	SRMR	RMSEA
	33.88	10	3.38	.94	.98	.93	.98	0.06	0.03

Deep approach directly and positively predicted the GPA by approximately 26% (R^2=0.265, p<0.05). Deep approach predicted academic self-efficacy directly by about 33% (R^2=0.331, p<0.05) and indirectly by almost 3%. The GPA directly and positively predicted academic self-efficacy by about 12% (R^2=0.116, p<0.05). Academic self-efficacy positively and directly predicted guidance (R^2=.333,

p<0.05), behavior management (R^2=.331, p<0.05), motivation (R^2=.321, p<0.05), teaching skill (R^2=.333, p<0.05), assessment & evaluation (R^2=.298, p<0.05) by approximately 33%, 33%, 32%, 33%, 33%, respectively. Deep approach indirectly and positively predicted guidance, behavior management, motivation, teaching skill, and assessment & evaluation by about 10%, 10%, 10%, 11%, 9%, respectively, via academic self-efficacy. Deep approach indirectly and positively predicted guidance, behavior management, motivation, teaching skill, and assessment & evaluation by about .09%, .09%, .09%, .09%, .08%, respectively, via GPA and academic self-efficacy. GPA indirectly and positively predicted guidance, behavior management, motivation, teaching skill, and assessment & evaluation by about 3%, 4%, 4%, 4%, 4%, respectively, via academic self-efficacy.

Figure 3. Surface study approach as the predictor of teaching efficacy and academic self-efficacy (Model 3)

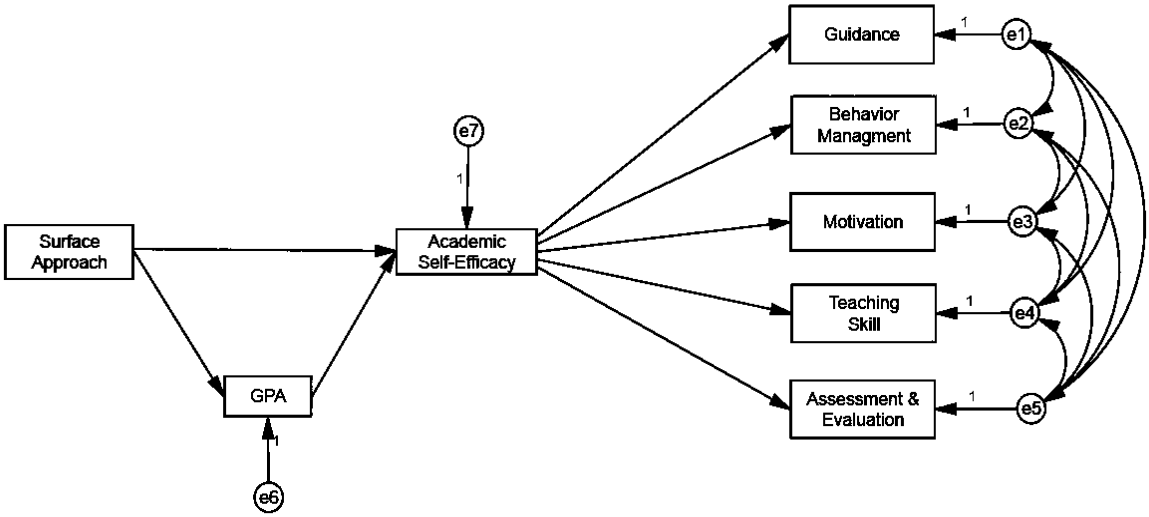
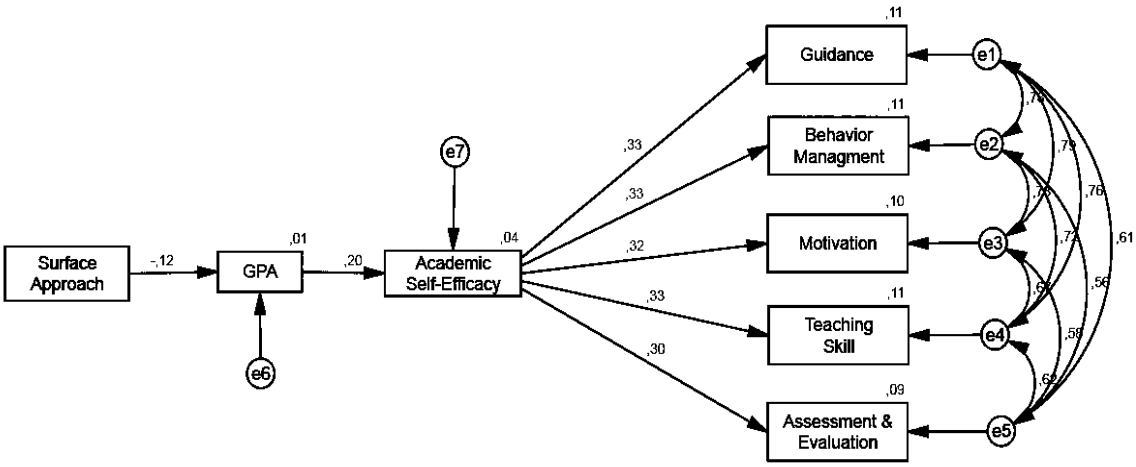


Figure 3 displays the model hypothesizing the surface approach as the predictor of teacher efficacy and academic self-efficacy (model 3). The analysis revealed that the hypothesis that surface approach predicted academic self-efficacy directly was statistically insignificant. This path was removed from the model, and the analysis was calculated again for the new model (Model 3.1).

Figure 4. Model 3.1



In model 3.1, it was hypothesized that surface approach predicted the GPA directly and academic self-efficacy indirectly via the GPA, and surface approach predicted teacher efficacy indirectly via GPA and academic self-efficacy. The fit indices and estimations for model 3.1 were given in Table 10.

Table 10. The fit indices and estimations for model 3.1

	Mediator/ Moderator		Estimates	Standard Error	C.R.	p	Direct Effect	Indirect Effect
Surface Approach	→	GPA	-0.121	0.065	-2.756	p<0.01	-0.121	-
GPA	→	Academic Self-Efficacy	0.204	0.021	4.723	p<0.001	0.204	-
Academic Self-Efficacy	→	Guidance	0.333	0.055	8.010	p<0.001	0.333	-
Academic Self-Efficacy	→	Behavior Management	0.331	0.054	7.964	p<0.001	0.331	-
Academic Self-Efficacy	→	Motivation	0.321	0.055	7.679	p<0.001	0.321	-
Academic Self-Efficacy	→	Teaching Skill	0.333	0.053	8.013	p<0.001	0.333	-
Academic Self-Efficacy	→	Assessment & Evaluation	0.298	0.065	7.068	p<0.001	0.298	-
Surface Approach	GPA	Academic Self-Efficacy	-	-	-	p<0.05	-	-0.025
Surface Approach	GPA	Guidance	-	-	-	p<0.05	-	-0.007
Surface Approach	GPA	Behavior Management	-	-	-	p<0.05	-	-0.008
Surface Approach	GPA	Motivation	-	-	-	p<0.05	-	-0.008
Surface Approach	GPA	Teaching Skill	-	-	-	p<0.05	-	-0.008
Surface Approach	GPA	Assessment & Evaluation	-	-	-	p<0.05	-	-0.008
GPA	→	Guidance	-	-	-	p<0.05	-	0.061
GPA	→	Behavior Management	-	-	-	p<0.05	-	0.068
GPA	→	Motivation	-	-	-	p<0.05	-	0.065
GPA	→	Teaching Skill	-	-	-	p<0.05	-	0.068
GPA	→	Assessment & Evaluation	-	-	-	p<0.05	-	0.068

Fit Indices

Model 1	chi^2	df	chi^2/df	GFI	AGFI	TLI	CFI	SRMR	RMSEA
	10.73	11	0.97	0.98	0.99	1.00	1.00	0.02	0.00

Surface approach directly and negatively predicted the GPA by approximately 12% (R^2=-0.121, p<0.05). The GPA directly predicted academic self-efficacy by about 20% (R^2=0.204, p<0.05). Academic self-efficacy directly and positively predicted guidance (R^2=.333, p<0.05), behavior management (R^2=0.331, p<0.05), motivation (R^2=0.321, p<0.05), teaching skill (R^2=.333, p<0.05), assessment & evaluation (R^2=.0298, p<0.05) by about 33%, 33%, 32%, 33%, 30%, respectively. Surface approach directly and negatively predicted academic self-efficacy by approximately 2% via the GPA. Surface approach indirectly and negatively predicted guidance, behavior management, motivation, teaching skill, and assessment & evaluation by about 0.07%, 0.08%, 0.08%, 0.08%, and 0.08%, respectively, via the GPA and Academic Self-Efficacy. The GPA positively and indirectly predicted guidance, behavior management, motivation, teaching skill, and assessment & evaluation by about 6%, 7%, 6%, 7%, and 7%, respectively, via academic self-efficacy.

DISCUSSION

In this study, students' study approaches were examined as the predictors of academic self-efficacy and teacher efficacy. The roles of the GPA and academic self-efficacy were also examined. The estimates of model 1.1 showed that surface approach decreased the GPA while deep approach increased it. Deep study approach increased academic self-efficacy directly and indirectly via the GPA. Academic self-efficacy belief increased the teacher efficacy beliefs. Moreover, deep approach affected teacher efficacy via academic self-efficacy. Based on these results, it can be deduced that the teacher candidates adopting deep study approach will have higher GPA. Accordingly, their academic self-efficacy perceptions will increase, and these students will feel more efficient about being teachers.

The GPA increased teacher efficacy perception via the academic self-efficacy. It is possible to say that the students having higher in GPA will believe their abilities related to academic tasks and subjects. This belief will increase the perceived teacher efficacy. The results of the model 1.1 showed that the students adopting surface approach would have lower scores in the GPA, accordingly the perception that increases when having deep approach would decrease. The students having surface approach may feel that they are insufficient in academic subjects such as exams, homework, and projects. This perception may affect teacher efficacy negatively. Model 2 hypothesizing that deep study approach affected the GPA directly, predicted academic self-efficacy both directly and indirectly, affected teacher efficacy indirectly via academic self-efficacy revealed that these hypotheses were accepted. Schunk and Pajares (2002) stated that the peer group could affect academic self-efficacy. Pajares (1996) suggested

that self-efficacy had an important role in predicting academic self-efficacy beliefs. According to Zimmerman (2000), efficient students will have the high level of academic achievements.

When the estimates of model 1.1 and model 2 were compared, it was seen that the impact of deep approach on the GPA, academic self-efficacy and teacher efficacy remained almost the same. When model 1.1 and model 3.1 were compared, the estimates related to surface approach displayed changes. The regression coefficient between the GPA and the surface approach was -.092, this value was found to be -.12. While the negative indirect effect of surface approach on academic self-efficacy via the GPA was found to be -.011, this effect was -.025 in model 3.1. The regression coefficient between the GPA and academic self-efficacy was found to be .11 while this value was .20 in model 3.1. In model 3.1, the direct effect of a surface approach on the GPA and an indirect effect on academic self-efficacy increased when compared with those in model 1.1. This effect was negative in each model. The direct effect of the GPA on academic self-efficacy and indirect effect on teacher efficacy increased in model 3.1. Based on these comparisons, it can be said that deep study approach reduces the negative effects of surface approach on academic self-efficacy and the GPA. It can be deduced that the role of the GPA is essential in the self-efficacy belief (academic and teacher efficacy) level of a student who is more likely to adopt the surface approach. The increment of the effect of the GPA on academic self-efficacy and teacher efficacy in the situation in which surface approach exists and deep approach does not exist can be shown as the most fundamental reason for this deduction. The fit indices of the models showed that the models had a good fit (Iacobucci, 2010; Hair et al., 2010; Hu & Bentler, 1999; Jöreskog & Sörbom, 1986; Bentler, 1995; Steiger & Lind, 1980; Kline, 2016).

Kember et al. (1995) have found a positive correlation between GPA and surface approach while there are studies indicating the relationship between interinsic motivation and deep approach (Entwistle & Ramsden, 2015). It was suggested that the individuals, having higher scores in deep approach, perceived studying as personal development, saw learning as a target while surface approach was related to a perception of a way leading to achieve kind of quality rather than understanding the instructional subject (Cassidy & Eachus, 2000). Phan (2007) revealed that academic self-efficacy was a determinant of the academic performance. There are studies showing similar results in the literature (Pajares & Johnson, 1996; Pajares & Miller, 1994, 1995). Moreover, there are results indicating that self-efficacy has a mediator role between the relations of academic performance, surface and deep approaches (Pajares & Kranzler, 1995; Pajares, Miller, & Johnson, 1999; Pajares & Valiante, 1997; Phan, 2007).

In this study, statistically significant differences were found between genders regarding surface approach ($p<0.05$, $t=-2.815$) and surface motivation ($p<0.05$, $t=-3.707$). Male students reported higher scores than females in surface motivation and approach. While some studies reported gender differences regarding the approaches to learning and studying (Cano, 2005; Pajares & Johnson, 1996; Pajares & Miller, 1994; Smith & Miller, 2005; Biggs, 1987; Dart, Burnett, Purdie, Boulton-Lewis, Campbell & Smith, 2000; Senel, Yeniyol, Köle & Adiloğulları, 2014), some stated there was no gender difference (Phan, 2007).

CONCLUSION

The results showed that deep study approach improved academic self-efficacy and teacher efficacy, increased academic achievement. Conversely, surface approach affected academic achievement negatively and decreased academic self-efficacy and teacher efficacy. The implications to change the study approaches of teacher candidates for adopting a deep approach to study and learning will have positive impacts on their academic and vocational development. The approaches of the students can be affected by various factors like teaching environment (Lizzio, Wilson & Simons, 2002). Surface and deep approaches have impacts on habitual behaviors, understanding, reflection, and academic performance (Phan, 2007). Kaye and Brewer (2013) stated that the grad students having formal instructions related to teaching had higher levels of teacher efficacy. Tuchman and Isaacs (2011) found similar results. It can be concluded that study approaches affect a various academic system. Bandura (1986) asserts that self-efficacy has an effective role in the human agency. Instructional designers, developers, and educationist should consider the approaches of students, the role of self-efficacy in human development. This study provides the information to work on changing surface behaviors and approaches of the students to educate efficient students. This study also shows the importance of

academic-self-efficacy and GPA to educate efficient teachers. With this aspect, educators can consider the ways of changing study approaches of the students.

RECOMMENDATIONS

This study is limited to the theoretical framework. These models should be tested with educational implications. The students in teacher education departments can be included in future studies. Including pedagogical formation students at different universities can expand the sample group. This study was conducted with a quantitative approach. Mix model methods and experimental studies can be conducted in the future.

REFERENCES

Adilogullari, I., & Şenel, E. (2014). Examination of The Relationship Between General Self-Efficacy Beliefs, Emotional Intelligence Levels and Emotional Self-Efficacy Levels Of Students In School Of Physical Education And Sport. *Anthropologist*, *18*(3), 893-902.

Azzi, R. G., Casanova, D. C. G., Dantas, M. A., & de Medeiros Maciel, A. C. (2011). 286-Academic Self-Efficacy and Learning and Study Strategies: Brazilian Students Perceptions. *ISATT 2011*, 659.

Baloğlu, N., & Karadağ, E. (2008). Teacher Efficacy and Ohio Teacher Efficacy Scale: Adaptation for Turkish Culture, Language Validity and Examination of Factor Structure. *Educational Administration: Theory and Practice*, *56*(56), 571-606.

Bandura, A. (1982). Self-Efficacy mechanism in human agency. *American Psychologist*, 37(2), 122–147.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. New Jersey: Prentice-Hall, Inc. Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W. H. Freeman and Company

Bandura, A. (1989). Social cognitive theory. In R. Vasta (Ed.), *Annals of child development*. Vol.6. Six theories of child development (pp. 1-60). Greenwich, CT: JAI Press.

Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of human behavior* (Vol. 4, pp. 71-81). New York: Academic Press.

Bentler, P. M. (1995). *EQS Structural Equations Program Manual*.Encino, CA: Multivariate Software, Inc.

Biggs, J. (1999). What the Student Does: teaching for enhanced learning, Higher Education Research & Development, 18:1, 57-75

Biggs, J. B. (1987). *The Learning Process Questionnaire (LPQ): Manual*. Hawthorn, Victoria: Australian Council for Educational Research.

Biggs, J., Kember, D., & Leung, D. Y. (2001). The revised two‐factor study process questionnaire: R‐SPQ‐2F. *British journal of educational psychology*, *71*(1), 133-149.

Cano, F. (2005). Epistemological beliefs and approaches to learning: Their change through secondary school and their influence on academic performance. *British Journal of Educational Psychology*, 75, 203–221.

Cassidy, S., & Eachus, P. (2000). Learning style, academic belief systems, self-report student proficiency and academic achievement in higher education. *Educational Psychology*, *20*(3), 307-322.

Dart, B. C., Burnett, P. C., Purdie, N., Boulton-Lewis, G., Campbell, J., & Smith, D. (2000). Students' conceptions of learning, the classroom environment, and approaches to learning. *Journal of Educational Research*, 93, 262–270.

Elliot, A. J., McGregor, H. A., & Gable, S. (1999). Achievement goals, study strategies, and exam performance: A mediational analysis. *Journal of educational psychology*, *91*(3), 549.

Entwistle, N. J., & Waterston, S. (1985). Approaches to studying and levels of processing: A comparison of inventories derived from contrasting theoretical bases. In *International Conference on Cognitive*

Processes in Student Learning, Lancaster University, England. Also, British J. of Educational Psychology.

Entwistle, N., & Ramsden, P. (2015). *Understanding student learning (Routledge Revivals)*. Routledge.

Hair, J. F, Jr, Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2010). SEM: an introduction. *Multivariate data analysis: a global perspective* (7th ed., pp. 629–686). Pearson Education: Upper Saddle River.

Hu, L.-T., & Bentler, P. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1–55.

Iacobucci, D. (2010). Structural equations modeling: Fit indices, sample size, and advanced topics. *Journal of Consumer Psychology*, *20*(1), 90-98.

Jerusalem, M. ve Schwarzer, R. (1981). *Fragebogen zur Erfassung von "Selbstwirksamkeit. Skalen zur Befindlichkeit und Persoenlichkeit* In R. Schwarzer (Hrsg.). (Forschungsbericht No. 5). Berlin: Freie Universitaet, Institut fuer Psychologie.

Jöreskog, K. G., & Sörbom, D. (1986). *LISREL VI: Analysis of linear structural relationships by maximum likelihood, instrumental variables, and least squares methods*. Scientific Software.

Juklová, K., Doležalová, J., Vrabcová, D., & Nowosad, I. (2015). *Learning and Reading Strategies of Future Teachers in International Comparison*. Wydawnictwo Adam Marszałek

Kaye, L. K., & Brewer, G. (2013). Teacher and Student-focused Approaches: influence of learning approach and self-efficacy in a psychology postgraduate sample. *Psychology Learning & Teaching*, *12*(1), 12-19.

Kember, D., Jamieson, Q. W., Pomfret, M., & Wong, E. T. (1995). Learning approaches, study time and academic performance. *Higher Education*, *29*(3), 329-343.

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). New York: The Guilford Press.

Lizzio, A., Wilson, K., & Simons, R. (2002). University students' perceptions of the learning environment and academic outcomes: implications for theory and practice. *Studies in Higher education*, *27*(1), 27-52.

Marton, F., & Säljö, R. (1976). On qualitative differences in learning: I—Outcome and process. *British journal of educational psychology*, *46*(1), 4-11.

Pajares, F. (1996). Self-Efficacy Beliefs in Academic Settings. Review of Educational Research, 66(4), 543-578.

Pajares, F., & Johnson, M. J. (1996). Self-efficacy beliefs and the writing performance of entering high school students. *Psychology in the Schools*, 33, 163–175.

Pajares, F., & Kranzler, J. (1995). Self-efficacy beliefs and general mental ability in mathematical problem-solving. *Contemporary Educational Psychology*, 20, 426–443.

Pajares, F., & Miller, M. D. (1994). Role of self-efficacy and self-concept beliefs in mathematical problem solving: A path analysis. *Journal of Educational Psychology*, 86, 193–203.

Pajares, F., & Miller, M. D. (1995). Mathematics self-efficacy and mathematics performances: The need for specificity of assessment. *Journal of Counselling Psychology*, 42, 190–198.

Pajares, F., & Valiante, G. (1997). Influence of self-efficacy on elementary students' writing. *The Journal of Educational Research*, 90, 353–360.

Pajares, F., Miller, M. D., & Johnson, M. J. (1999). Gender differences in writing self-beliefs of elementary school students. *Journal of Educational Psychology*, 91, 50–61.

Phan, H. P. (2007). An examination of reflective thinking, learning approaches, and self-efficacy beliefs at the University of the South Pacific: A path analysis approach. *Educational Psychology*, *27*(6), 789-806.

Phan, H. P. (2011). Interrelations between self-efficacy and learning approaches: a developmental approach. *Educational Psychology*, *31*(2), 225-246.

Ramsden, P. (1988). Context and strategy. In Schmeck, R. R. (Ed.) *Learning strategies and learning styles* (pp. 159-184). Springer, Boston, MA.

Richardson, J. T. E. (2008). *Approaches to studying among deaf students in higher education*. In M. Marschark, & P. C. Hauser (Eds.), Deaf cognition: Foundations and outcomes (pp. 387−410). New York: Oxford University Press.

Richardson, J. T. E. (2011). Approaches to studying, conceptions of learning and learning styles in higher education. Learning and Individual Differences, 21, 288–293

Salamonson, Y., Weaver, R., Chang, S., Koch, J., Bhathal, R., Khoo, C., & Wilson, I. (2013). Learning approaches as predictors of academic performance in first-year health and science students. *Nurse Education Today*, *33*(7), 729-733.

Schunk, D. H., Pajares, F. (2002). The development of academic self-efficacy. In A. Wigfield & J. Eccles (Eds.), Development of achievement motivation. San Diego: Academic Press.

Senel, E., Adilogullari, İ., & Ulucan, H. (2014). Examination of Emotional Intelligence Level, Teacher's Self-Efficacy Beliefs and General Self-Efficacy Beliefs of Teachers. *Journal of Physical Education & Sports Science/Beden Egitimi Ve Spor Bilimleri Dergisi*, *8*(2).

Senel, E., Yeniyol, C., Köle, Ö., Adilogullari, İ. (2014). Examination of the Relation Between School of Physical Education and Sport Students' Approach to Learning and Studying and Test Anxiety. *Niğde University Journal of Physical Education and Sport Sciences, 8*(1), 140-148.

Smith, N., & Miller, R. J. (2005). Learning approaches: Examination type, discipline of study, and gender. *Educational Psychology*, 25, 43–53.

Steiger, J.H, & Lind, J. C. (1980, May). *Statistically based tests for the number of common factors*. Paper presented at the annual meeting of the Psychometric Society, Iowa City, IA.

Taylor, R. (1990). Interpretation of the correlation coefficient: A basic review. *JDMS*, 1, 35 - 39.

Tschannen-Moran, M., & Woolfolk-Hoy, A. (2001) Teacher efficacy: Capturing an elusive concept. Teaching and Teacher Education, 17, 783-805

Tuchman, E., & Isaacs, J. (2011). The influence of formal and informal formative pre-service experiences on teacher self-efficacy. *Educational Psychology*, 31, 413-433. http://dx.doi.org/10.1080/01443410.2011.560656

Yılmaz, M. B., & Orhan, F. (2011). The Validity and Reliability Study of the Turkish Version of the Study Process Questionnaire. *Education and Science*, *36*(159), 69-83.

Yılmaz, M., Gürçay, Y., & Ekici, G. (2007). Adaptation of the academic self-efficacy scale to Turkish. *H. U. Journal of Education*, 33, 253-259.

Zimmerman, B. J. (2000). Self-efficacy: an essential motive to learn. *Contemporary Educational Psychology,* 25, 82–91. DOI: 10.1006/ceps.1999.1016.

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Talent Classification of Motoric Parameters with Support Vector Machine

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Abstract

Aim: In recent years, the methods of analysis of data science have started to be used frequently in talent selection in sports and the evaluation of athletes. Based on the motor and physical measurements of the future athletes, determining which sport branch they are prone to is important in terms of training and resource planning. Within the scope of this study, it was aimed to propose a classification system to determine which sports branches the participants are suitable for, based on motor and physical measurements.

Material and Methods: Measurements of height, arm span, body weight, 20-meter sprint test, vertical jump height, 1 kg medicine ball throw, back strength, hand grip strength, flexibility test and standing long jump values were recorded with the contribution of 1240 participants who are 9 years old. Afterwards, grouping procedures were carried out with classification methods based on Support Vector Machines (SVM). Radial based functions are used as kernel functions of SVM. The results of evaluations made by consulting expert opinion beforehand were accepted as actual values, compared with the classification results and the performances of the classifiers were calculated. Within the scope of this study, participants were classified into four as rapidity branch (E), strength branch (F), height branch (G) and other group (H).

Results: The accuracy values of classification of support vector machines were found ranging from 96% to 100% in each class, and 98% in average. Minimum value of sensitivity was found to be 93% while it was 99% in maximum. On the other hand, precision varied between 92% and 100%.

Conclusion: In the light of the information provided, successful classification of the test dataset using the the model that is formed by the training dataset, points out a possible high classification accuracy of big test datasets even in the use of a small dataset in the training phase.

Keywords
Talent selection,
Classification,
Support Vector Machines

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INTRODUCTION

Given that the sport contributed much to the individual and the society, it is an undeniable fact that it has become a social need requiring persistence. It is thought that directing athletes to the branches where they can use the features they have at a young age in the most appropriate way is the most fundamental and the most important step in their achievement, in order for them to achieve success in the sports branch they are involved in. In studies of talent selection, a framework that is the golden standard in practice has not been established until ten years ago (Vaeyens, Lenoir, Williams & Philippaerts, 2008). "Sports talent" usually refer to the individuals who are thought to have a high degree of predisposition or a particular tendency for sports efficiency due to hereditary or later gained behavioral conditions (Karl, 2001). While trainers of elite athletes see themselves as experts when their knowledge and skills they gained in their branches are enriched with their experiences, sports scientists have a strong belief that only the measurements carried out can represent reality (Buekers, Borry & Rowe, 2015). These two ideas should be blended for success in sports. In recent studies, qualitative and numerical methods are used in the literature to determine the position of the players for the team game. Based on numerical methods, Bayesian networks, Decision trees and k-nearest neighbors have been shown to achieve high accuracy in making decision by eliminating personal prejudices (Razali, Mustapha, Yatim & Aziz, 2017). The mental, physical and technical skills of the players are taken into account and the players' states in different positions are classified with 98% of accuracy. The trainer was provided with a system with which he could quantitatively measure the strengths of the players, and it was thought to support him in deciding. As a matter of fact, a test scale was developed by bringing it into the use of 20 trainers in order to evaluate the system qualitatively and 80 per cent of the users found the system usable. In a recent study, relation between performance and anthropometric measurements obtained from young

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wheelchair basketball players were investigated and the sitting height and functional ability were found to be correlated with performance (Cavedon, Zancanaro & Milanese 2015).

Today, advances in computer science have facilitated the processing of large-scale data and accelerated the information extraction. In a recent study carried out by Woods, Veale, Fransen, Robertson & Collier (2018), players were classified in terms of their positions according to their technical abilities. In their study, 12 game positions of 4 Australian elite football players were classified using three separate analyzes, and achieved a maximum accuracy rate of 70 per cent in the analysis results. All these developments can be considered to be a sign of the importance of the talent orientation decision support system in directing the players to the branches.

Artificial Neural Networks (ANN) as a part of machine learning strategy was implemented to perform the prediction of sports results (Bunker & Fadi, 2017). The prediction of results regarding to horse races, (Davoodi & Khanteymoori, 2010) and the results of rugby and soccer matches (McCabe & Trevathan, 2008) were computed by the use of previous data in ANN.

Within the scope of this study, classification results were achieved by comparing the values obtained with the application of the classification techniques which accept the parameters including the physical and motor characteristics as input to the trainer views. The grouping of the athlete candidates based on their abilities was carried out according to the trainer's view, and grouped by using Support Vector Machines.

In the materials and methods section, information is provided about how motor properties are gathered and the classification method being applied. The findings section contains the results of the classification method applied. Finally, the discussion section includes the comparison of the classification findings with the literature.

METHODS

Physical parameters

In order to train and test the classification methodology, the participants' measurements include height, arm span, body weight, 20-meter sprint test, vertical jump height, 1 kg medicine ball throw, back strength, hand grip strength, flexibility test and standing long jump tests.

Height was measured by using tape measure with the help of a tape sticked to the wall. The athletes, without shoes, put their heels together and lean on the tape measure, and the arms are hanging freely on their sides. The back, hips, back of the head and heels stand upright verging to the vertical scale. The subject stands by first taking a deep breath and in this position the ruler is brought to the top of the head and the hair is compressed sufficiently and the measurement is noted (Coşan, Demir & Mengütay, 2002) The subject leans on the wall, arms are stretched parallel to the floor and back of the hand touches the wall; while in this position, the arm span parameter was calculated with the help of a tape measure by measuring the distance between the middle fingers of the right and left arms (Coşan et al.) Body weight (kg) is known to be strongly related to muscle mass. In some other sports branches, the basic force is predominant (Gündüz, 1997). The 20 m sprint (secs) is a 20 meters flat track that is precisely measured and its start and finish lines are clear. The starting position is standing. The subject starts when he is ready and tries to complete the 20-meter course as soon as possible. When they start, the photocell works and when they reach the end zone, the photocell stops. They run twice and the best rating is taken into account (Kamar, 2003). An amount of chalk enough to leave a mark on the wall is applied on the middle finger of the athlete for the vertical jump height measurement (cm), and he touches vertically the highest point where the arm can reach, beneath the jumping platform. This part is taken as the zero point and its difference with the highest point is determined as the jump test. At the moment of jump, the subject stands at the tip of the toe as the knee is slightly twisted. With a sudden movement, the vertical legs bounce and the arms are lifted up to the highest point that he can touch on the marking platform. The distance between the marking part and the jump height gives the jump value. The measurement is taken twice and the best attempt is recorded (Coşan et al.). For 1 kg medicine ball throw (m), the athlete tries to throw a medicine ball weighing 1 kg, with both hands over the head, as far away as possible from where he stands. The athlete takes his position just behind the starting line and one step ahead. It is not allowed to run at the moment of throwing. By bending his body backwards, the subject can obtain the necessary acceleration for the throw. The medicine ball should be thrown using both hands. The test

score is the recording of the throwing distance in meters and centimetres. The best score obtained at the end of two trials is recorded (Kamar). For back strength measurement, the subject stands on the dynamometer platform with his back straight, his head upright and his knees tight. While grasping the bar, the right-hand palm faces the body and the back of the left hand faces the body and the chain is adjusted to form the intended uprightness. The subject pulls the bar strongly upwards using the back muscles, without bending backwards. The shoulders move backwards during pulling. Prior to the movement, the subject should bend his body forward very mildly, with his head held upright. The needle of the dynamometer stops at the point where the maximum is reached. Two trials are carried out with a minute interval. For the hand grip strength test, the hand grip measure is usually adjusted in a way that the subject can use easily. The hand length can be measured with a caliper and the value found can be used for the optimal grip size. The subject stands upright, his arms are on his side. The dynamometer is held on the side, in a parallel position to the body. The dynamometer is squeezed as strongly as possible without moving the arm. Generally, 3 trials are carried out with 1-minute intervals, for both hands (Özer, 2006). For the flexibility test, the subject is seated on the floor and the sole of the foot is rested against the test stand in an upright position. Leaning forward from the body, the knees being straight, the hands being held ahead, the subject reaches forward as far as he can. He waits for two seconds before stretching forward or backward. The test is repeated twice and the higher value is accepted (Tamer, 1991). For standing long jump, tape measure is sticked onto a flat ground. The athlete is positioned behind the starting line. Tips of the athlete's toe take a relaxed standing position behind the starting line. Tips of the subject's toe should be behind the starting line. With the command heard, the subject pulls the arms backwards and tries to jump as far as possible from the starting line. The distance between the starting line and the nearest heel of the athlete to this line is recorded as the score. Two trials are performed and the best rating is recorded in cm (Kamar)

Participants

This study involves the measurement values of 9-year-old students who participated in the study voluntarily within the scope of the project called "Talent Identification in Sports and Sports Orientation", conducted jointly by Gaziosmanpaşa District Governorate, Gaziosmanpaşa Municipality, Gaziosmanpaşa District Directorate of National Education and Gaziosmanpaşa Youth Services and District Directorate of Sports in the province of Gaziosmanpaşa, Istanbul. This study received ethical approval from Ethics Committee of Institute of Health Sciences of Marmara University dated 08.01.2018 and by decision no 2018-13. In the scope of the study, data from 4183 participants were collected between 2015 and 2017 and all participants were divided into four different groups according to the expert trainers' opinions. These groups were characterized as height, strength, rapidity, and other. The number of members of the groups was 310, 314, 444 and 3115, respectively. Since the number of participants included in the last group is very high compared to other groups and it can bring about bias in classification performance, it is necessary to equalize the number of participants in the groups. This can be done in two different ways. Increasing the number of participants in the group with the smallest number of members can be considered as a solution, but it does not seem practical in the context of this study. On the other hand, another method is to select participants from the other groups by random sampling, equal to the number of members in the group with the smallest number of members. Within the scope of this study, 310 participants from each group were randomly selected, and a total of 1240 participants' data were selected for use. 60% of these participants were used to train classifiers, and the remaining 40% were used for testing purposes. Thus, the samples of 186 participants belonging to each group were used for the training of classifiers, while the samples of 124 participants were used for testing purposes.

Classification with Support Vector Machines: Support vector machines, as a supervised learning method, perform multiclass classification process and all possible binary classifications, and complete the classification process by using the knowledge of which classes each training data belongs to the most. Support vector machines use hyperplanes to reduce the classification error by dividing training data belonging to two classes so that data is farthest from each other. In this study, classification process was applied in Phyton environment. SVC from the Scikit library was used to implement classifier. Radial basis kernel was used in SVM.

Classifier Performance Metrics: The performance of the classifier is evaluated with precision, sensitivity, accuracy, f-score and support parameters by looking at the number of correct and incorrect measurements. Table 1 represents the confusion matrix for four classes.

Table 1. Definitions of confusion matrix belonging to multi-class classifier

	True: Class E	True: Class F	True: Class G	True: Class H
Predicted: Class E	True	False 2-> 1	False 3-> 1	False 4-> 1
Predicted: Class F	False 1-> 2	True	False	False
Predicted: Class G	False 1-> 3	False	True	False
Predicted: Class H	False 1-> 4	False	False	True

When Table 1 is examined, the correct classification is observed as diagonal elements. In addition, while the columns show the correct classes, the lines represent the predicted classes. Accuracy is the ratio of the sum of the numbers getting to the diagonal elements to the sum of the numbers of the elements appearing in all the cells. The ratio of the diagonal element on a column to the sum of the elements on that column is called the accuracy parameter of that class. Precision is the ratio of the number of correctly predicted data, which are called true positives, to the data determined incorrectly to be in that class, which are called false positives. False positives are also referred to as type 1 error in statistics. The ratio of true positives to the sum of true positives and false negatives is defined as recall/ sensitivity. False negative is the state of mistakenly identifying a faulty condition.

Sensitivity criterion and precision criterion, when evaluated separately, are not sufficient for us to get meaningful comparison outcome. In order to obtain the correct result, the parameter defined as the weighted harmonic mean of precision and sensitivity is called F-score. It is obtained when twice the product of sensitivity and precision parameters is divided by the sum of the sensitivity and precision parameters. The number of elements per class is indicated by the support parameter.

RESULTS

The accuracy values of the SVM reached to 98% in average over the classes. The classification evaluation parameters achieved the values close to %100 which is an indicator of the high performance classification. Results of the SVM was summarized in Figure 1 and Table 2. In Figure 1. the relationship between the true positive and false positive values was drawn. The dotted black line represent the random classification performance. As seen from Figure 1., for each class, accuracy values were 100%, 99%, 98% and 96%, respectively.

Figure 1. Support vector machines classification scores

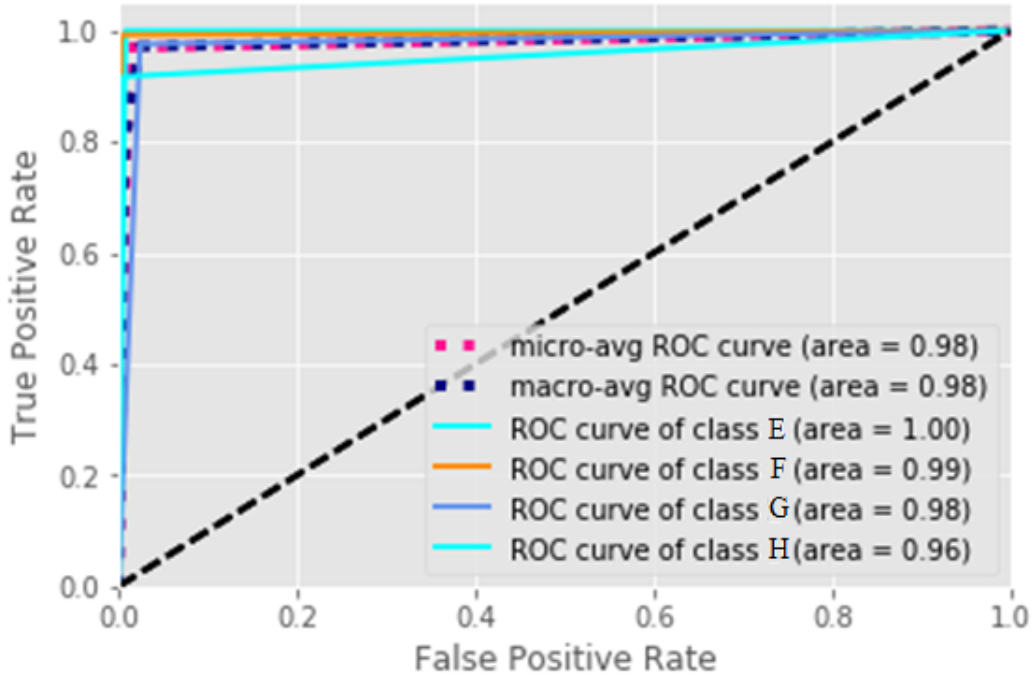

Table 2 Decision support tree classification technique test data confusion values

Variables	E	F	G	H
Precision	1	0.99	0.98	0.92
Recall	0.97	0.99	0.93	0.98
F1-score	0.99	0.99	0.95	0.95
Support	116	126	130	124

CONCLUSION

The popularity of sports throughout the world has increased, ensuring more focus on the performance of the athletes. Unless the physical characteristics of the athletes are not suitable for the sport branch they are in, their performance will not reach adequate levels (Aydos, 1991). In individual and team sports, athletes must have body structures that are in accordance with the characteristics of the branch in order to reveal their physiological, physical and motoric properties. In these conditions, it is necessary to select athletes considering the needs of the branches. The properties required by various sports branches differ. Badminton sports, for instance, require sudden moves in every direction, bounces and sudden changes of direction (Sharif, George & Ramlan, 2009). Since Badminton is a sport involving speed, talent, mobility, reaction and aesthetics, badminton athletes should have good reaction, jumping strength and speed, and they should have a slim body structure. It is believed that if the badminton player has a good level of speed in terms of performance, this will provide a significant advantage for the elbowroom in the court to reach from the midcourt to the corners and from the corners to the center point (Omosegoard, 1996). Athletics, which is another branch, embodies distance, time and height. The runners represent the fight against time, the jumps against the distance, and the throws against the height (Çalışkan, 2013). The height criteria of the athletes have a direct effect on performance in some sports branches, but they also affect performance indirectly in some other branches (Gündüz, 2005). The anthropometric feature and jumping capacity of the volleyball player is an important factor directly affecting the performance of the team (Clarke, 1975). In branches such as volleyball and handball, it is a visible feature that athletes are tall, as well as having low body fat percentage. It is thought that it provides an important advantage in defensive and offensive positions in basic technical and tactical games (Pehlivan, 1997). According to the International Amateur Wrestling Federation (FILA), wrestling is defined as a struggle for supremacy between two individuals, without the use of any tool, on a mattress in a designated size, with the use of techniques, skills, powers and mind and within a framework of rules (Öcal, 2007). In addition, wrestling is a sport that makes progress depending on the strength of the body to a large extent (Cicioğlu, Kürkçü, Eroğlu & Yüksel, 2007). Boxing is one of the fighting sports in the world that requires a high level of power and has a complex structure due to its dynamic and static characteristics (Mitchell, Willams & Reter, 1999). Boxing workouts provide the athlete with a major improvement in physical and physiological characteristics, including aerobic power, muscle strength and endurance, hand eye coordination and flexibility, rapidity and reflexes. In order to be able to exhibit high performance in the football field, it is considered that if the athletes have a high level of explosive speed and durability in terms of physical properties, and if their motor skills are blended with anthropometric properties, it is an inevitable success (Figueirdo, Gonçalves & Coelho, 2009; Vaeyens, Malina, Janssens, Van Renterghem, Bourgois, Vrijens et al., 2006). In a high-level soccer match, it was measured that the professional footballers covered approximately 10 km of the total distance they had during the game with an intensity close to anaerobic threshold, at a maximal heart rate (80-90%) (Stolen, Chamarı, Castagna, & Wisloff, 2005) Football is a sports branch where aerobics and anaerobic loads are used intensively, intermittent rests are present, and performance is created by speed, agility, flexibility, mobility, coordination and muscular endurance (Akgün, 1994). In terms of its technical properties, judo is a defensive art that does not show resistance to the reaction of the opponent, and even uses opponent's strength to defeat the opponent himself (Manfred, 1979). One of the most important factors in the basketball branch is the height. By measuring the height of the athlete, a number of predictions can be made for his height in the future. Evaluating the athlete's parents' height also contributes positively to the estimates (Magill, 1989). Looking at the studies above, speed, strength, height, coordination and endurance characteristics are needed for each sport branch. However, when the needs of the branches are examined, the priority order of these properties is constantly changing. In line with this need, we can classify sport branches as rapidity branches, strength branches and height branches.

Metodologically, there is a limited usage of classical statistical tests in the talent grouping studies since the datasets being used have high inter parameter correlation as well as high number of parameters (Till, Ben, Jones, Cobley, Morley, O'Hara et al., 2016).

In a recent study, a binary classification study was performed for a group soccer group. The groups were designed as selected players and non-selected players. Based on their perceptual and cognitive parameters, high classification level was reported (93.7%) (O'Connor, Larkin & Mark 2016). However, in our study, more groups were used and better evaluation scores were achieved. Within the scope of this study, participants were classified into four as rapidity branch (E), strength branch (F), height branch (G) and other group (H). The classification accuracy of support vector machines varied from 96% to 100% in each class, and 98% in average. In the light of the information provided, it has been observed that the support vector machines have achieved the high performance. The model formed using the training set, classified the dataset which has not been used in the training with a high accuracy points out a possible high classification accuracy of big test datasets even in the use of a small dataset in the training phase.

CONCLUSION and RECOMMENDATIONS

The classification to an increased number of class is going to be enhanced by the use of physiological and psychological parameters in the training dataset. The fact that classifier techniques use a knowledge gained from existing data to create a decision support system will make it easier to introduce a model that will contribute to the talent selection. In future studies, it is aimed to classify data belonging to different age groups and to test systems with larger number of samples.

REFERENCES

Akgün, N. (1994) Egzersiz Fizyolojisi. İzmir: Ege Üniversitesi Basımevi.

Aydos, L. (1991) Fiziksel Uygunluk, Gazi Eğitim Fakültesi Dergisi, 69-79.

Bunker, R.P. & Fadi, T. (2017) A machine learning framework for sports result prediction, Applied Computing and Informatics, https://doi.org/10.1016/j.aci.2017.09.005

Buekers, M., Borry, P., Rowe, P. (2015) Talent in sports. some reflections about the search for future champions. Movement & Sport Sciences – Science & Motricit´e; 88, 3–12

Cavedon, V., Zancanaro, C., Milanese, C. (2015) Physique and Performance of Young Wheelchair Basketball Players in Relation with Classification. PLoS ONE 10(11): e0143621. https://doi.org/10.1371/journal.pone.0143621

Cicioğlu, H., Kürkçü, R., Eroğlu, H., & Yüksel, S. (2007) 15-17 Yaş güreşçilerin fiziksel ve fizyolojik özelliklerinin sezonsal değişimi: Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi 5: 1 51-6.

Clarke, O.H. (1975) Exercise Physiology, Prentice Hall. New Jersey, USA.

Coşan, F., Demir, A., Mengütay, S. (Ed). (2002) Türk Çocuklarının Fiziki Uygunluk Normları. İstanbul Olimpiyat Oyunları Hazırlık ve Düzenleme Kurulu Eğitim Yayınları Yayın No 1., İstanbul.

Çalışkan, O. (2013) Özel düzenlenmiş Plyometrik antrenmanların atletizm yapan 11-13 yaş çocukların aerobik ve anaerobik güçlerine etkisi. Yüksek Lisans Tezi, Aksaray Üniversitesi Sosyal Bilimler Enstitüsü. Aksaray.

Davoodi, E. & Khanteymoori, A. (2010) Horse racing prediction using artificial neural networks, Recent Adv. Neural Networks, Fuzzy Syst. Evol. Comput., pp. 155-160

Figueiredo, A.J., Gonçalves, C.E., Coelho, E., et al. (2009): Youth soccer players, 11-14 years: Maturity, size, function, skill and goal orientation. Annals of Human Biology (36), 60-73.

Gündüz, N. (2005) Antrenman Bilgisi, Birinci baskı, İzmir, Saray Medical Yayıncılık, sf. 21 22.

Gündüz, N. (1997) Antrenman Bilgisi. Saray medikal yayıncılık 2. Yayın İzmir; s.23

Kamar, A. (2003) Sporda Yetenek Beceri ve Performans Testleri. Nobel Yayın Dağıtım. Ankara; s.40-41

Karl, K. (2001) Sporda Yetenek Arama Seçme ve Yönlendirme Antrenör Eğitim Dizisi. Bağırgan Yayınevi., Ankara.

Magill, A.R. (1989) Motor learning Concepts and Applications, Third Ed. Iowa, Wch, Publishers, 17-34

Manfred, B. (1979) Training, Technik, Taktik: Reinbek. International Congress on judo. 1979

Mccabe, A., & Trevathan, J. (2008). Artificial Intelligence in Sports Prediction. 1194-1197. 10.1109/ITNG.2008.203.

Mengütay. S., Demir, A., Coşan, F. (2002) Olimpiyatlar İçin Sporcu Kaynağı Projesi, Olimpiyat Hazırlık ve Düzenleme Kurulu Eğitim Yayınları. İstanbul No 2, 102.

Mitchell, H., Willams, L., & Reter, B.R. (1999) Classification of sports medicine and science in sports and exercise. American college of sports. Medicine and the American College of Cardiology, 56-85.

O'Connor, D., Larkin, P., Mark, W.A. (2016) Talent identification and selection in elite youth football: An Australian context. Eur J Sport Sci. Oct;16(7):837-44

Omosegoard, B. (1996) Physical Training for Badminton. İnternational Badminton Federation (JJBF)Denmark.

Öcal, D, (2007) Elit Güreşçilerin Somototip Özellikleri ile Anropometrik Oransal İlişkilerinin Stiller ve Sikletler Arası Karşılaştırılması. Yüksek Lisans Tezi, Gazi Üniversitesi Sağlık Bilimleri Enstitüsü ve Spor Anabillim Dalı, Ankara.

Özer, K. (2006) Fiziksel Uygunluk. 2. Baskı, Nobel Yayın Dağıtım. İstanbul s. 11, 118-120, 160.

Pehlivan, Z. (1997) 1995-1996 sezonunda Türkiye 1. Deplasmanlı Bayanlar Basketbol, Hentbol ve Voleybol Liglerinde Şampiyon olan sporcuların fiziksel ve fizyolojik özelliklerinin değerlendirilmesi; Gazi Üniversitesi Sağlık Bilimleri Enstitüsü Yüksek Lisans Tezi 1997.

Razali, N., Mustapha, A., Yatim, A.F., Aziz, A.R. (2017) Predicting player position for talent identification in association football. International Research and Innovation Summit (IRIS2017). IOP Conf. series: materials science and engineering.; 226 012087

Sharif, A.H., George, J., Ramlan, A.A. (2009) Musculoskeletal Injuries Among Malaysian Badminton Players. Singapore Med J. Nov; 50(11); 1095-7.

Stolen, T., Chamari, K., Castagna, C., Wisloff, U. (2005). Physiology of soccer. Sports Medicine. 35(6):501–536.

Tamer, K. (1991) Fiziksel Performansın Ölçülmesi ve Değerlendirilmesi. (Egzersiz Fizyolojisi Laboratuvar Rehberi) Gökçe offset matbaacılık Ankara. S.32

Till, K., Ben, L., Jones, S., Cobley, D., Morley, J., O'Hara, C., Chapman, C., Cooke, and Clive B. Beggs, (2016) Identifying Talent in Youth Sport: A Novel Methodology Using Higher-Dimensional Analysis, PLoS One. 2016; 11(5): e0155047.

Vaeyens, R., Lenoir, M., Williams, M.A., Philippaerts, M.P. (2008) Talent identification anddevelopment programmes in sport current models and future directions. Sports Med. 38 (9): 703-714

Vaeyens, R., Malina, R.M., Janssens, M., Van Renterghem, B., Bourgois, J., Vrijens, J. et al. (2006) A multidisciplinary selection model for youth soccer. The Ghent Youth Soccer Project. British Journal of Sports Medicine (40), 928-934.

Woods, T.C., Veale, J., Fransen, J., Robertson, S., Collier, N.F. (2018) Classification of playing position in elite junior Australian football using technical skill indicators, Journal of Sports Sciences, 36:1, 97-103.

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SCUBA Dalışlarının Solunum Fonksiyonlarına Akut Etkisi

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Özet

Amaç: Dalış, solunan gaz yoğunluğunun artışı, soğuk ve kuru hava soluma, immersiyonun etkisi, oksijen toksisitesi, kabarcıkların akciğerlerde filtrasyonu gibi nedenlerle solunum fonksiyonlarında değişikliklere yol açmaktadır. Bu değişiklikler daha çok az sayıda profesyonel dalgıcı ilgilendiren derin ve özel dalışlarda incelenmiştir ve çoğunlukla uzun süreli etkiler araştırılmıştır. Günümüzde milyonlarca insanın giderek artan bir yoğunlukla katıldığı SCUBA dalışları hakkında araştırma ise oldukça azdır. Bu çalışmada kısa süre yapılan SCUBA dalışlarının solunum fonksiyonları üzerine etkilerinin incelenmesi amaçlanmaktadır.

Materyal ve Yöntem: Bu çalışma Beden Eğitimi Yüksek Okulu öğrencilerinin 5 günlük dalış eğitimleri sırasında 49'u erkek 24'ü kadın 73 sporcu üzerinde yürütülmüştür. Beş gün boyunca her gün sabah dalışlardan önce ve akşam tüm dalışlar tamamlandıktan sonra solunum fonksiyon testleri yapılmıştır. Dalış verileri dalış bilgisayarları ile toplanmıştır. Çalışma sonunda solunum parametrelerinde günlük ve dönemlik değişimler incelenmiştir.

Bulgular: Ölçümler boyunca solunum parametrelerinden hacim değerlerini ilgilendiren FVC ve FEV_1 değerlerinde anlamlı değişiklikler saptanmamıştır. Akım hızlarını ilgilendiren PEF değerleririnde beş gün boyunca anlamlı bir değişiklik olmazken FEF_{25-75}'in beş gün boyunca azalma eğiliminde olduğu ve bu azalmanın dalışların son günü anlamlılık kazandığı görülmüştür.

Sonuçlar: Kısa süreli SCUBA dalışlarının akciğer kapasitelerinde değişikliğe sebep olmadığı ancak küçük hava yollarında daralmaya yol açabileceği gösterilmiştir. Ardışık SCUBA dalışlarının kısa dönemde etkisinin araştırıldığı çalışma olmaması nedeni ile bu sonuç oldukça önemlidir. Etkilerin geçici olup olmadığı ve dalış derinlikleri ya da süreleri gibi faktörlerle ilişkisinin araştırılması için ileri çalışmalar gereklidir.

Anahtar Kelimeler
Rekreasyonel dalış,
Akciğer hacmi,
Akım hızları,

Yayın Bilgisi
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Acute Effects of SCUBA Diving on Respiratory Functions

Abstract

Aim: Diving causes changes in respiratory functions due to increase in density of the breathing gas, inhaling cool and dry air, immersion effect, oxygen toxicity, bubble filtration through lungs. These changes were studied only in deep and specialized dives which are performed mostly by professional divers and generally long term effects of diving on lungs were analyzed. Studies about SCUBA dives that became an interest to millions of people lately are scarce. The aim of this study is to evaluate the effects of short-term SCUBA diving on respiratory functions.

Methods: This study was conducted on 73 School of Sports Training students (49 male, 24 female) during a five day diving course. Respiratory function tests were carried out daily before morning dives and after afternoon dives for five days. Diving data were collected by dive computers all through the study period. At the end of the course, daily and periodic changes in respiratory parameters were investigated.

Results: It was found that FVC and FEV_1 values which are related to lung volumes did not change significantly all through the dives. No significant change was observed in PEF values, as FEF_{25-75} values decreased through five days and the difference was significant on the fifth day.

Conclusion: This study showed that short term SCUBA diving does not affect lung volumes but it may cause an obstruction in the small airways. This result is important due to there are not any studies that evaluate acute effects of consecutive SCUBA dives. Further studies are needed to investigate whether the effects are temporary and their relationship with factors such as dive or durations.

Keywords
Recreational diving,
Lung volumes,
Respiratory flow,

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GİRİŞ

Dalış insan fizyolojisinde pek çok değişikliğe sebep olmaktadır. Bunların başında da solunum sisteminde oluşan değişiklikler gelir. Dalış sırasında akciğerler, artmış oksijen parsiyel basıncına, daha yoğun, soğuk ve kuru bir solunum gazına (çoğu kez hava), artmış solunum yüküne ve dekompresyon sırasında oluşan mikro kabarcıklara maruz kalır. Bu faktörler solunum fonksiyonları üzerindeki uzun ve kısa dönem etkileri merak uyandıran bir konudur.

Dalışın solunum fonksiyon parametreleri üzerine etkileri konu alan pek çok kesitsel (cross-sectional) ve boylamsal (longitudinal) araştırma yapılmıştır. Bu çalışmaların çoğu profesyonel dalgıçlar ve askeri dalgıçlar üzerinde yürütülmüş ve dalışın bu bireyler üzerinde etkilerini incelemiş ve karşılaştırmıştır (Sames, Gorman, Mitchell, Zhou, 2018; Voortman, Van Ooij, van Hulst ve diğ., 2016). Bunların dışında tek dalışın etkileri satürasyon dalışları gibi çok derin ve uzun dalışlarda araştırılmıştır (Thorsen, Segadal, Stuhr ve diğ., 2006). Ayrıca az da olsa serbest dalışın etkilerini araştıran çalışmalar da vardır (Diniz, Farias, Pereira ve diğ., 2014). Bu çalışmaların bir kısmı bazı açılardan çelişkili sonuçlar ortaya koysa da genel olarak dalışın solunum üzerine uzun dönemde hafif fakat belirgin bir etkisi bulunduğu ve bu etkinin yaşla birlikte artarak emeklilik döneminde belirginleştiği gösterilmiştir. Bu değişikliklerin çoğu hafiftir ve dalgıcın yaşam kalitesini etkilemez ancak ilerleyen dönemlerde dalgıcın sonraki sağlığını etkileme riski her zaman vardır (Tetzlaff, Thomas, 2017).

Öte yandan dünyada yapılan dalışlar ağırlıklı olarak sportif ve eğlence amaçlıdır. Bunlara donanımlı dalış ya da SCUBA *(Self Contained Underwater Breathing Apparatus)* dalışı ismi verilmektedir. Bu dalışlar, etkisi araştırılmış olan dalış gruplarına göre pek çok açıdan (derinlik, süre ve yapıldığı ortam) oldukça farklıdır. Sportif dalıcıların sayısı son yıllarda askeri ve profesyonel dalgıçlarla kıyaslanamaz şekilde artmıştır (Participation in recreational diving report, 2015). Mesleğe başlamadan ve başladıktan sonra da düzenli aralıklarla sağlık kontrolünden geçen bu dalgıçların aksine sportif dalıcılar için hiçbir tıbbi kontrol zorunluluğu yoktur. Bu sayede hiçbir kısıtlama olmaksızın her yaş grubundan, her türlü hastalığı olan birey dalış yapabilmektedir. Tüm bunlara rağmen sportif dalışların solunum fonksiyonları üzerine etkileri araştırılmamıştır. Bu çalışmada kısa süreli SCUBA dalışlarının solunum fonksiyonları üzerine etkisi ve bu etkilerin dalış parametreleri ile ilişkisinin araştırılması amaçlanmıştır.

MATERYAL ve YÖNTEM

Çalışma İstanbul Üniversitesi, İstanbul Tıp Fakültesi Etik Kurulu'nca görüşülmüş ve 2439 sayılı kararı ile onaylanmıştır.

Çalışma grubu ve dalış planı

Çalışma, Marmara Üniversitesi, Spor Bilimleri Fakültesi dalış kulübünün 2013 Haziran'da düzenlediği dalış gezisi sırasında yürütüldü. Ölçümler dalış gezisine katılmış olan ve hepsi elit atlet öğrenciler ile yapıldı. Tamamı en az Türkiye Sualtı Sporları Federasyonu (TSSF) 1 yıldız belge sahibi olan öğrencilerin bir kısmı dalış seviyelerini geliştirmek üzere eğitim almakta iken bir kısmı da eğitim vermekteydi. Öğrencilere çalışma hakkında bilgi verilerek yazılı onamları alındı ancak beklenen sonuçlar açıklanmadı. Çalışma, üniversite kulüplerinin rutin dalış eğitimlerine yönelik olarak planlandığından, dalış türü, dalış sıklığı, dalış derinliği vs gibi konularda herhangi bir uyarı yapılmadı, değişiklik önerilmedi. Dalışlarda tam donanımlı SCUBA malzemeleri ıslak elbise ile birlikte kullanıldı. Tüm öğrencilerin benzer dalış malzemesi ve ıslak elbise gkullanması sağlandı. Dalış yapılan dönemde su sıcaklığı 18-23 ^{0}C arasında değişmekteydi. Tüplerin dolumunda kullanılan kompresörün bakımı ve filtresinin değişimi dalış yapılan dönemden hemen önce yapılmıştı.

Dalışlar sırasında her dalıcı sol koluna Suunto marka D9tx (Finlandiya) model dalış bilgisayarı taktı. Her günün sonunda dalış bilgisayarlarında saklanan dalış bilgileri, cihazın kendine ait bilgisayar programını taşıyan bir dizüstü bilgisayarına yüklendi. Dalış bilgisayarından her 10 saniyede bir elde edilen derinlik ve zaman verileri; yüzeyi terk ile yüzeye varış arasında geçen süre (Toplam Dalış Zamanı, TDZ); dalınan en fazla derinlik (Maksimum Derinlik, MD) elde edildi.

Solunum Fonksiyon Testi Ölçümleri

Dalıcılarda beş gün boyunca sabah dalışa başlamadan önce solunum fonksiyon testi ölçümleri yapıldı. Bu ölçümler her gün son dalış bitiminden sonra en geç bir saat içinde tekrarlandı. Solunum fonksiyon testi ölçümlerinde Schiller marka SP-1 model spirometre (Baar, İsviçre) kullanıldı. Cihaz her sabah ilk

ölçümden önce kalibre edildi. Solunum fonksiyon testi parametrelerinden "hacim" değerlendirmeleri için FVC (zorlu vital kapasite) ve FEV_1 (1. Saniye zorlu ekspirasyon hacmi) parametreleri ölçüldü. Solunum foksiyonlarının "akım" özelliğinin değerlendirilmesi için ise PEF (ekspirasyon tepe akım hızı), ve FEF_{25-75} (zorlu ekspirasyon ortası akımı-%25-75) parametreleri kullanıldı. Dalış yapılan bölgede ve tekne üzerinde gerçekleşmesi imkânsız bulunan DLCO ölçümleri ve egzersiz kapasitesini değerlendirecek ölçümler çalışmamıza katılamamıştır.

İstatiksel Analiz

Solunum fonksiyon testi parametrelerinin her biri için tüm katılımcılara ait beş günlük dalış öncesi ve sonrası ölçümler ve dalış bilgisayarından sağlanan dalışa ilişkin veriler Microsoft Excel 2016 programına aktarılarak işlendi. Demografik bilgiler ve her bir parametrenin günlük değerleri ortalama ve standart sapma (SS) olarak verildi. İstatistik değerlendirme, MedCalc istatistik programı kullanılarak yapıldı. Verilerin normal dağılım gösterdiği Kolmogornov-Smirnov testi ile gösterildi. İstatiksel analiz için demografik verilerin ve dalış bilgilerinin karşılaştılmasında bağımsız örneklem t-testi ve ki kare testi, parametrelerin günlük değerlerinin karşılaştırılmasında tekrarlı ölçümler Anova testi kullanıldı. Tüm karşılaştırmalarda istatistik açıdan anlamlılık $p<0,05$ düzeyinde kabul edildi.

BULGULAR

Genel özellikler: Çalışmaya 49'u erkek (%67,12), 24'ü kadın (%32,88) 73 elit sporcu katıldı. Katılımcıların yaş ortalaması 25,1±6,1 yıl, boy ortalaması 176,2±7,7 cm ve vücut ağırlığı 75,5±15,9 kg idi. Dalışlar sırasında 15 katılımcı eğitmen olarak görev aldı. Eğitmenlerin 4'ü kadın (%16,7) 11'i erkek (%22,4) idi. Eğitmenler ve öğrenciler arasında cinsiyet dağılımı yönünden istatiksel bir fark saptanmadı. (p=0,569) Katılımcıların dalış bilgileri Tablo 1'de verilmiştir.

Tablo 1. Çalışmaya dahil edilen katılımcıların demografik özellikleri ve dalış bilgileri

	KADIN (n=24)	ERKEK (n=49)
Eğitmen	4 (%16,7)	11(%22,4)
Yaş (yıl)	22,7 ± 3,4	26,3 ± 6,8
Boy (cm)	168,9 ± 6,5	179,8 ± 5,3
Vücut ağırlığı (kg)	59,6 ± 6,2	85,6 ± 12,6
Günlük dalış sayısı	2,4 ± 0,7	2,5 ± 0,5
Günlük maksimum derinlik (mt)	21,7 ± 3,4	22,6 ± 5,7
Günlük toplam dalış zamanı (dk)	74,2 ± 7,3	76,6 ± 6,4

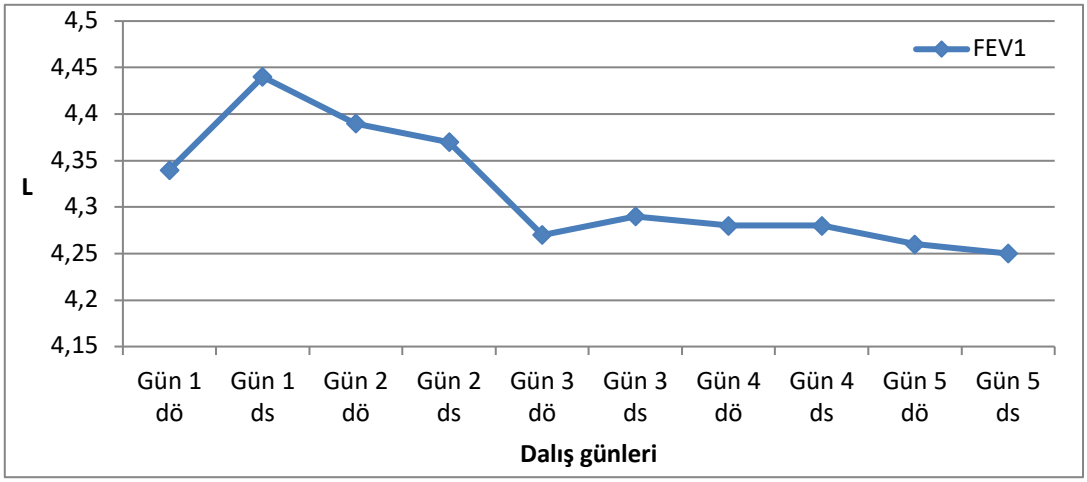
Çalışmaya katılan erkekler kadınlardan istatiksel olarak daha yaşlı (p=0,017), daha uzun (p<0,0001), ve daha ağır (p<0,0001) idi. Kadın ve erkek kartılımcılar arasında eğitmen oranı açısından fark olmamakla beraber her iki grubun günlük dalış sayıları, dalınan maksimum derinlikleri ve dalış zamanları benzer saptandı. (Sırası ile p=0,486; 0,489; 0,155) Dalış performansları açısından kadın ve erkek katılımcılar arasında fark yoktu.

Solunum fonksiyonları

Her bir parametre için tüm katılımcıların her gün dalış öncesi ve sonrası ölçümlerini içeren tablolar ve bu değerlerin karşılaştırma sonuçlarını içeren tablolar ilave materyal olarak sunulmuştur.

FEV_1: Sabah ve akşam ölçümleri karşılaştırıldığında, değerlerde günlük artma ya da azalma olmakla birlikte hiçbir günde anlamlı farklılık saptanmadı. (Tüm günler için p=1,000). (Tablo 2) Beş gün boyunca ölçülen tüm FEV_1 değerleri birbirleri ile karşılaştırıldığında, birinci gün dalış sonrası ölçümde artış sonrasında dalgalı bir seyir ile azalma izlendi. (Şekil 1) Birinci gün dalış sonrası ölçülen FEV_1; 3. gün dalış öncesi (p=0,008), 4. gün dalış öncesi ve sonrası (p=0,014 ve 0,041) ve 5. gün dalış öncesi ve sonrası (p=0,037 ve 0,032) ölçülenlerden anlamlı şekilde fazla idi. Ayrıca 2. gün dalış öncesi FEV_1 ile 3. gün dalış öncesi FEV_1 arasında anlamlı fark (p=0,03) saptandı. Yine de beşinci gün sonunda ulaşılan değer başlangıç değeri ile karşılaştırıldığında anlamlı azalma saptanmadı. (p=1,000) (Tablo 4)

Şekil 1: FEV_1 değerlerinin günlük dalış öncesi ve sonrası değişimleri. dö: dalış öncesi; ds: dalış sonrası, L: litre

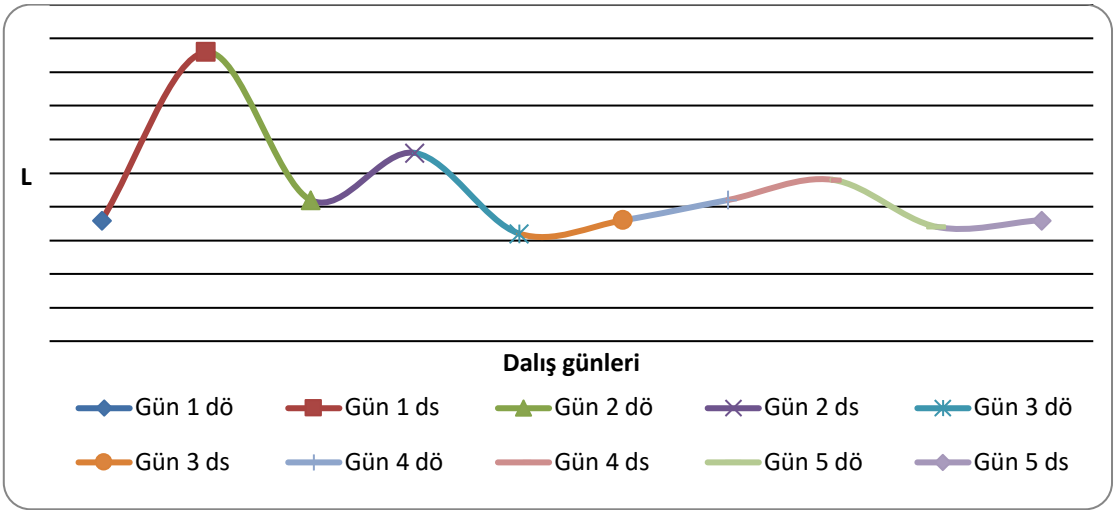


Tablo 2. Beş gün boyunca ölçülen FEV_1, FVC ve FEV_1/FVC değerlerinin günlük dalış öncesi ve dalış sonrası ortalamaları ve gün içi değişimlerinin karşılaştırmaları. L: litre

	FEV_1 (L)			FVC (L)			FEV_1/FVC		
	Dalış Öncesi	Dalış Sonrası	p	Dalış Öncesi	Dalış Sonrası	p	Dalış Öncesi	Dalış Sonrası	p
Gün 1	4,34±0,84	4,44±0,81	1,000	5,18±1,04	5,43±1,02	0,087	0,83±0,13	0,82±0,08	1,000
Gün 2	4,39±0,78	4,37±0,85	1,000	5,21±0,97	5,28±1,06	1,000	0,85±0,07	0,83±0,09	1,000
Gün 3	4,27±0,82	4,29±0,87	1,000	5,16±1,03	5,18±1,10	1,000	0,83±0,08	0,84±0,09	1,000
Gün 4	4,28±0,86	4,28±0,82	1,000	5,21±1,02	5,24±1,03	1,000	0,83±0,09	0,82±0,08	1,000
Gün 5	4,26±0,89	4,25±0,85	1,000	5,17±1,07	5,18±1,01	1,000	0,81±0,13	0,82±0,08	1,000

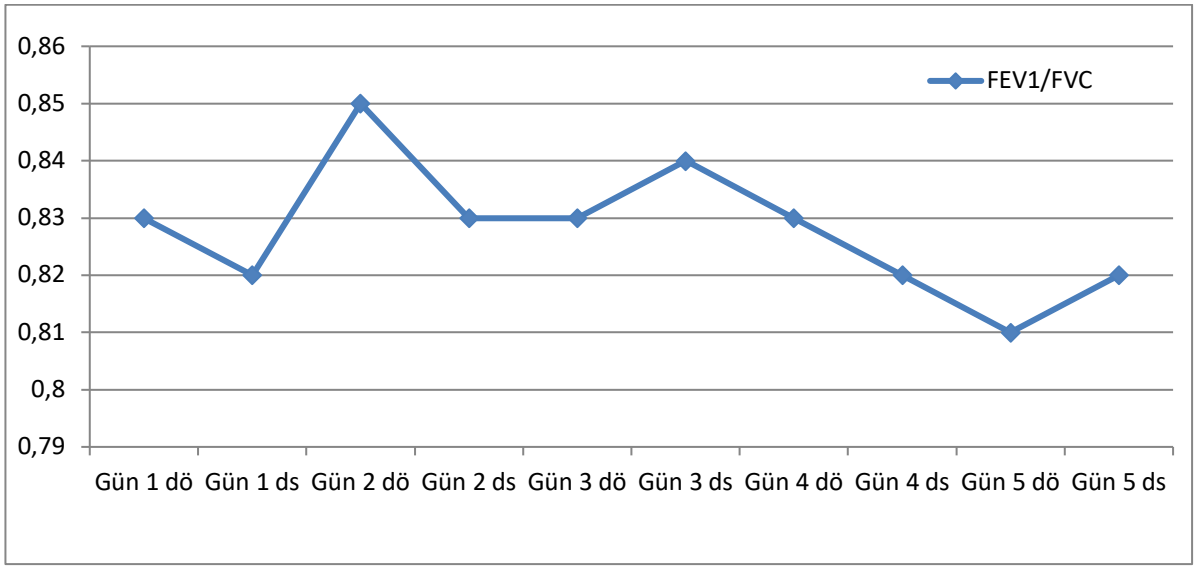
FVC: Sabah ve akşam ölçümleri karşılaştırıldığında, değerlerde günlük artma ya da azalma olmakla birlikte hiçbir günde anlamlı farklılık saptanmadı. (Birinci gün p=0,087, diğer günler için p=1,000). (Tablo 2) Beş gün boyunca ölçülen tüm FVC ölçümleri birbirleri ile karşılaştırıldığında, birinci gün dalış sonrası ölçümde artış sonrasında dalgalı bir seyir ile azalma izlendi. (Şekil 2) Birinci gün dalış sonrası FVC değeri, 2. gün dalış öncesi (p=0,031); 3 gün dalış öncesi ve sonrası (p=0,008 ve 0,029); 4. gün dalış öncesi (p=0,001) ve 5. gün dalış öncesi ve sonrası (p=0,005 ve 0,011) ölçümlerinden anlamlı olarak daha yüksek saptandı. Beşinci gün sonunda ölçülen değer ile başlangıç değerleri arasında ise anlamlı bir fark yoktu. (p=1,000) (Tablo 4)

Şekil 2: FVC değerlerinin günlük dalış öncesi ve sonrası değişimleri. dö: dalış öncesi; ds: dalış sonrası, L: litre



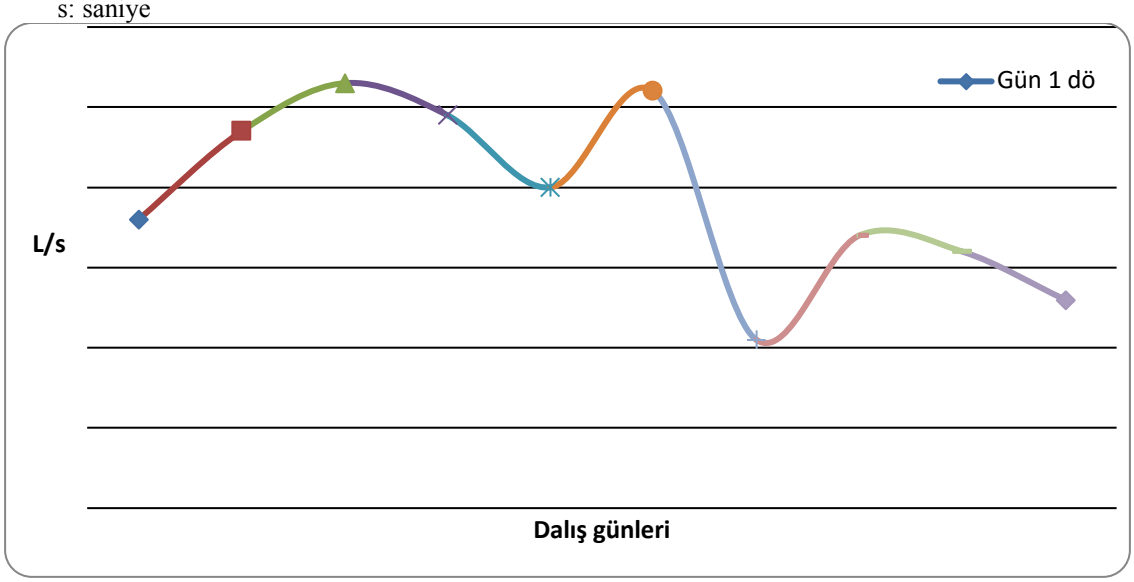
FEV$_1$/FVC: Sabah ve akşam ölçümleri karşılaştırıldığında, değerlerde günlük artma ya da azalma olmakla birlikte hiçbir günde anlamlı farklılık saptanmadı. (Tüm günler için p=1,000). (Tablo 2) Beş gün boyuncaki tüm FEV$_1$/FVC oranları birbirleri ile karşılaştırıldığında ise dalgalı bir seyir izlemekteydi. (Şekil 3) En yüksek oran ikinci gün dalış öncesi ölçüldü ancak bu sadece 1. gün dalış sonrası, 4. gün dalış sonrası ve 5. gün dalış sonrası oranlardan istatiksel olarak fazla idi. (sırası ile p=0,0001; 0,025; 0,008) Diğer ölçümlerde istatiksel olarak anlamlı artma ya da azalma saptanmadı. Başlangıç değeri ile beşinci gün dalış sonrası oranı arasında da anlamlı bir değişiklik saptanmadı. (p=1,000) (Tablo 4)

Şekil 3: FEV$_1$/FVC oranının günlük günlük dalış öncesi ve sonrası değişimleri. dö: dalış öncesi; ds: dalış sonrası



PEF: Dalış öncesi ve dalış sonrası ölçülen PEF değerlerinin beş gün boyunca anlamlı bir değişiklik göstermedi (tüm günler için p=1,000) (Tablo 3). Günlük karşılaştırmalar yapıldığında ise dalgalı bir seyir görülmekle beraber hiçbir ölçüm arasında istatistiksel açıdan anlamlı bir farkı bulunmadı (tüm ölçümler için p>0,05). (Şekil 4) Beşinci gün ölçümleri ile başlangıç ölçümü arasında da istatistik açıdan fark bulunmamaktaydı (p=1,000). (Tablo 4)

Şekil 4: PEF değerlerinin günlük dalış öncesi ve sonrası değişimleri. dö: dalış öncesi; ds: dalış sonrası; L: litre; s: saniye

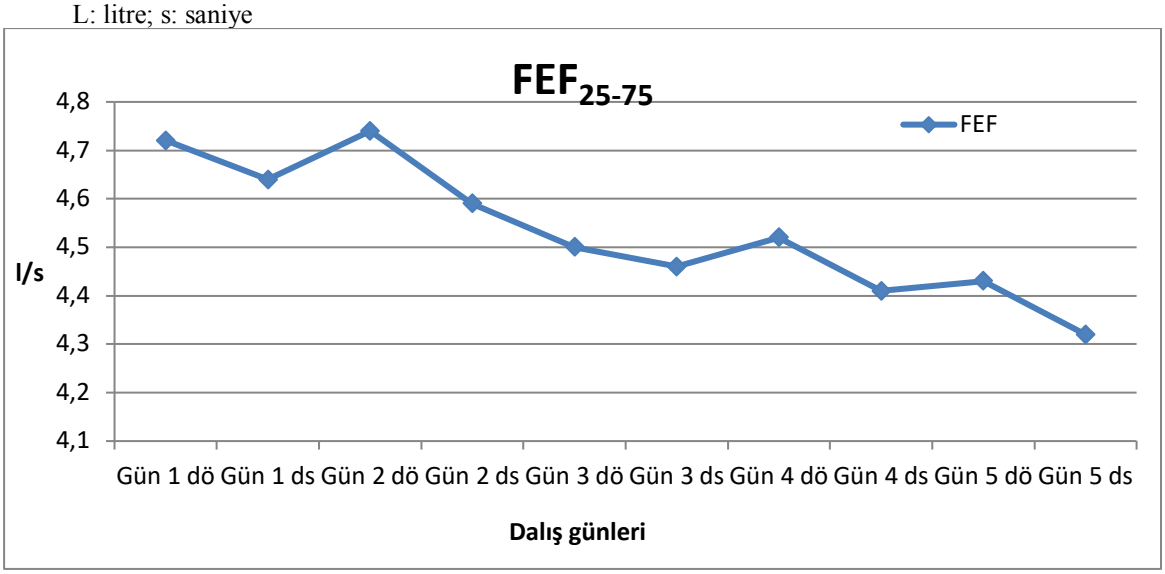


Tablo 3. Beş gün boyunca ölçülen PEF ve FEF_{25-75} değerlerinin günlük dalış öncesi ve dalış sonrası ortalamaları ve gün içi değişimlerinin karşılaştırmaları. L: litre

	PEF			FEF_{25-75}		
	Dalış Öncesi	**Dalış Sonrası**	**p**	**Dalış Öncesi**	**Dalış Sonrası**	**p**
Gün 1	8,36±1,99	8,47±2,01	1,000	4,72±1,27	4,64±1,30	1,000
Gün 2	8,53±1,94	8,49±2,0	1,000	4,74±1,40	4,59±1,37	1,000
Gün 3	8,40±1,96	8,52±1,83	1,000	4,50±1,29	4,46±1,46	1,000
Gün 4	8,21±2,0	8,34±1,86	1,000	4,52±1,42	4,41±1,29	1,000
Gün 5	8,32±2,1	8,26±1,92	1,000	4,43±1,33	4,32±1,27	1,000

FEF_{25-75}: Sabah ve akşam ölçümleri karşılaştırıldığında, dalış öncesi ölçümleri hep sonrası ölçümlerden daha yüksek olmakla birlikte hiçbir günde anlamlı farklılık saptanmadı. (Tüm günler için p=1,000) (Tablo 3) Beş günlük ölçümler değerlendirildiğinde FEF değerlerinde sadece 2. gün dalış öncesi bir artış olurken diğer günlerde düzenli bir azalma eğilimi olduğu görüldü. (Şekil 5) İstatiksel olarak anlamlı azalma ise birinci gün dalış öncesi ile 4. ve 5. gün dalış sonrası (p=0,022 ve 0,0008); 2. gün dalış öncesi ile 4. Gün dalış öncesi (p=0,005) ve yine 4. ve 5. gün dalış sonrası (p=0,016 ve p<0,001) ölçülen değerlerde saptandı. Başlangıç ile son gün değerleri arasında yukarıda belirtildiği üzere anlamlı düşüş vardı. (Tablo 4)

Şekil 5. FEF_{25-75} ölçümlerinin beş günlük dalış öncesi ve sonrası değişimleri. dö: dalış öncesi; ds: dalış sonrası; L: litre; s: saniye



Tablo 4. Tüm parametrelerin başlangıç ve son değerlerinin karşılaştırması.

	Gün 1 Dalış Öncesi	**Gün 5 Dalış Sonrası**	**p**
FEV1	4,34±0,84	4,25±0,85	1,000
FVC	5,18±1,04	5,18±1,01	1,000
FEV1/FVC	0,83±0,13	0,82±0,08	1,000
PEF	8,36±1,99	8,26±1,92	1,000
FEF25-75	4,72±1,27	4,32±1,27	0,001

TARTIŞMA

Dalışın solunum sistemi ve fonksiyonları üzerine birçok etkisi olduğu bilinmektedir. Basınç artışı ve buna bağlı olarak solunan havanın yoğunluğunun artması, solunum direncinde artış ve hava yollarında oluşan ölü boşluklar, solunan havanın soğuk ve kuru oluşu, egzersiz yükü, solunum ritm ve karakterinin değişmesi ile immersiyon bu etkilerin ortaya çıkmasında önemli faktörlerdir. Ayrıca solunan gazların parsiyel basınçlarının artışına bağlı etkiler de gözlenir (Wilson, 2011).

Bir gazın solunum yollarından akışı için gereken basınç, gazın fiziksel özellikleri ve akım hızı ile doğrudan ilişkilidir. Gazın fiziksel özelliklerinden dalış sırasında en fazla etkileneni gazın yoğunluğudur. Bu yoğunluk artan çevre basıncı ile direkt orantılıdır. Gazın yoğunluğun artması solunmasını zorlaştırır ve solunum direncini arttırır. Yapılan çalışmalarda solunum kapasitesinin gaz dansitesinin karekökü ile ters orantılı olduğu gösterilmiştir (Tetzlaff, Thomas, 2017). Direncin artmasına bir sebep de regülatörün kendisidir. Warkander, Hagasawa ve Lundgren (2001) inspiratuar ve ekspiratuar kabul edilebilir en düşük direnci saptamak için basınç odası içinde hava soluyan 5 dalgıcı 4,5 metreye ve 57 metreye daldırmışlar ve VO_2 max'larının %60'ı oranında egzersize almışlardır. Kullanılan regülatörün inspirasyon veya ekspirasyon yönüne değişen şiddette direnç uygulama sonucunda özellikle inspirasyon direncine karşı dispne skorunda, end-tidal CO_2 oranında ve istemli maksimum soluma oranlarında değişimler sağlamışlardır. Artmış solunum direncinin yanında solunum ekipmanından kaynaklanan ölü boşluk da su altında solunum yükünün artmasında rol oynar.

SCUBA tüpü içine kompresör aracılığıyla doldurulan havanın nemi alınır. Bu kuru havanın sıcaklığı dalış sırasında hızla su sıcaklığına düşer. Basınçlı hava, regülatörün birinci ve ikinci kademelerinden geçerek dalınan derinlikteki basınca eşitlenir. Gazın basıncındaki bu azalma gazın daha da soğumasına yol açar. Böylece dalış sırasında solunan hava soğuk ve kurudur. Solunum yollarında soğuk havanın ısıtılması ve kuru havanın nemlendirilmesi evaporasyon yoluyla ısı kaybına yol açar. Soğuk hava solunarak yapılan dalışlarda çok kısa sürede bol miktarda sekresyon ortaya çıkar. Bu sekresyon hava yollarında tıkanma ile solunum sıkıntısına yol açar. Kuru ve soğuk hava ile yapılan dalış çalışmalarında akciğer kapasitelerinde ve akım parametrelerinde azalmalar birçok çalışma ile gösterilmiştir (Uhlig, Muth, Tetzlaff ve diğ., 2014).

Su içinde boyuna kadar immersiyon, su yüzeyinde olan ağız ile akciğer ortası hizasında 20-25 cmH2O'luk bir basınç farkı yaratır. Bu şekilde negatif basınçta soluma, akciğer hacimlerinin azalıp solunum direncinin artmasına ile solunum yükünün artmasına neden olur (Agostoni, Gurtner, Torri ve diğ., 1966). Ayrıca karın ve ayaklar daha aşağıda olduğundan hidrostatik basınç bu bölgeler üzerinde daha belirgindir ve bu basınç nedeniyle toraks içine taşınan kan miktarında artış olur. Kanın toraks içine doğru yer değiştirmesi kardiovasküler yükü arttırır. SCUBA dalışında olduğu gibi su içine tam batmada bu değişiklikler azalır. Yine de normal dalışlarda sıkça gözlendiği gibi su içinde tam yatar pozisyonda olmadıkça ağızda bulunan regülatör ile daha aşağıda bulunan akciğer orta hattı arasında basınç farkı oluşabilir. Uzun süreli negatif basınçta solumak, solunum fonksiyonlarında değişikliklere yol açabilir. Dalınan suyun soğuk olması da hem hiperventilasyona yol açarak hem de vazokonstriksiyonu arttırarak bu değişikliklerin daha belirgin olmasına neden olur. (Tipton, 2016). SCUBA ekipmanı, dalış elbisesi, ağırlıklar özellikle de sıkı giyilmişse göğüs çevresinde baskıya neden olurlar ve solunum yükünü arttırırlar.

Dalış sırasında gazların parsiyel basınçlarının artışı da solunum fonksiyonlarını etkileyebilir. Bunların başında da oksijen ve nitrojen gelir. Oksijenin parsiyel basıncının artması ile oluşan hiperoksi akciğer dokusunda oksidatif strese ve havayollarında inflamasyona sebep olur. (Van Ooij, Hollmann, van Hulst, Sterk, 2013). İnert bir gaz olan nitrojenin ise parsiyel basıncının artması ile dokularda çözünürlüğü artar. Çıkış sırasında basıncın azalması ile birlikte de dokulardan vasküler sisteme geri atılır. Bu sırada venöz sistemde sessiz mikrokabarcıklar oluşur ve bu kabarcıklar arteryel dolaşıma geçmemeleri için akciğerlerden filtre edilir. Bu filtrasyonunun da akciğer vasküler yapısında inflamasyona oluşturabileceği ve solunum fonksiyonları üzerine etkisi olabileceğinin gösteren çalışmalar vardır. (Thom, Milovanova, Bogush ve diğ., 2012) Daha derin dalışlarda ise nitrojenin narkotik etkilerinden kurtulmak için helyum gibi gazlar kullanılabilir. Fiziksel özellikleri farklı olan bu gazların da solunum fonksiyonları üzerine benzer etkiler vardır.

Tüm bunların yanında tüplere doldurulan basınçlı hava yetersiz ve bakımsız kompresör nedeniyle istenilen temizlikte olmayabilir. Karbonmonoksit ve diğer aromatik gazlar, su buharı ve yağlar solunum havasına karışarak akciğer dokusunda zararlı etkilere yol açabilir.

Dalışın solunum fonksiyonları üzerine etkileri sıklıkla askeri ve profesyonel dalgıçlarda incelenmiştir. Çalışmalarda çoğunlukla bir grupta yıllar içinde birikici etki araştırılmıştır. Daha eski çalışmalarda ise uzun süredir dalış yapmakta olan bireyler, dalış yapmayanlarla karşılaştırılmıştır. (Voortman ve diğ., 2016; Sames, Gorman, Mitchell ve diğ., 2009). Sonuçlar çelişkilidir; bazı çalışmalarda hiçbir etki gösterilememişken bazılarında solunum fonksiyonlarında gerileme olduğuna dair bulgular vardır. (Pougnet, Pougnet, Lucas, Uguen, Henckes ve diğ., 2014). Bu çalışmaların

nereyse tamamı dalışın uzun dönem etkileri ile ilgilidir. Spesifik olarak SCUBA dalışlarının etkilerini inceleyen çalışmalar sınırlıdır ve bir kısmı yine askerler ve profesyonel dalgıçlar ile yapılmıştır. (Tetzlaff, Theysohn, Stahl, Schlegel, Koch, Muth, 2006) Rekreasyonel amaçla yapılan SCUBA dalışlarını konu alan az sayıdaki çalışmada solunum fonksiyonlarında bozulma olduğu gösterilmiştir. (Lemaître, Tourny-Chollet, Lemouton, 2006) Ancak bunlar da uzun süredir dalış yapmakta olan deneyimli dalgıçlardaki birikici etkiyi inceleyen çalışmalardır. SCUBA'nın kısa sürede solunum üzerine etkisi bilinmemektedir.

Ardışık SCUBA dalışlarının solunum fonksiyonlarını akut olarak nasıl etkilediğinin araştırıldığı çalışmamızda küçük hava yollarında daralmayı işaret eden bulgular saptanmıştır. Küçük hava yollarında akımı gösteren FEF_{25-75} değerlerinde günler içerisinde azalma olmuş ve başlangıç ve son gün değerleri arasında anlamlı bir fark oluşmuştur. Bu dalışın küçük hava yollarında minimal daralmaya sebep olduğunu göstermektedir. FEV_1 ve FVC değerlerinde oluşan azalma ise ilk günde oluşan artışın ardından gelmektedir. Dolayısı ile gerçek bir azalma olduğunu söylemek mümkün değildir. Aynı zamanda bu sürede FEV_1/FVC oranı ve PEF'te değişiklik olmayışı da obstrüksiyon gelişmediğini göstermektedir. İlk dalış gününün ardından oluşan hacim artışları oluşan solunum yüküne cevap olarak solunum kaslarının daha kuvvetli kasılmasına bağlı olduğu düşünülebilir. (Lemaître ve diğ., 2006) Sonrasında, fonksiyonların normale dönmesi ise adaptasyon gelişmesi olarak yorumlanabilir.

Yapılan çalışma için öğrenci dalış kulübünün seçilme nedeni rekreasyonel dalışlara uygun bir örnek olmasıdır. Sportif ya da rekreasyonel dalışlar, kısıtlı bir topluluğun katıldığı ve bir amaca yönelik yapılan askeri ve profesyonel dalışlardan aksine genellikle daha kısa süreli, daha sığa ve sıklıkla tatillerde yapılan eğlence amaçlı dalışlardır. Bir öğrenci sualtı kulübünün yaptığı dalış gezisi bu tip bir dalışın tüm özelliklerini taşır. Genellikle 4-7 gün süren bu katılımcıların dalış derinlikleri, dalış süreleri ve günlük dalış sayıları benzerdir. Dalış derinlikleri 1 yıldız dalıcılar için 15 mt, 2 yıldız dalıcılar için 30 mt ile sınırlı iken dalış süreleri nadiren bir saati bulur. Günlük dalış sayısı ise eğitmenler hariç en fazla ikidir; ilk dalışı daha derine, ikinci dalış ise daha sığa yapılır. Eğitmenler ikiden fazla sayıda dalış yapmak zorunda kalabilirler. Bu özellikler tatillerinde dalış gezilerine giden sportif dalıcıların yaptığı dalışlarla oldukça benzerdir. Bu nedenlerle öğrenci kulübü tarafından düzenlenen geziler bizim çalışmamız için ideal bir ortam sağlamıştır.

Çalışmamızın sınırlılıkları da vardır. Bunların başında çalışmaya katılan grupta kontrol ölçümlerinin yapılamamış olmasıdır. Dalışlardan bir süre sonra yapılacak kontrol spirometri ile dalış ile oluşan değişikliklerin normal sınırlara dönme eğilimi gösterilebilir, bu sayede etkinin kalıcı ya da geçici olması ile ilgili fikir edinilebilir. Zamansal kısıtlamalar nedeniyle kontrol ölçümleri yapılamamıştır. Her ne kadar çalışma grubu, sportif dalıcıları iyi temsil etse de beden eğitimi meslek okulu öğrencilerinden oluştuğu için genel olarak düzenli sağlık kontrollerinden geçen, fit ve çoğunlukla genç bireylerden oluşmaktadır. Bu da sonuçlarda bias (tek yanlılığa) neden olmuş olabilir. Değerlendirilirken bu durum göz önünde tutulmalıdır.

SONUÇ ve ÖNERİLER

Sonuç olarak çalışmamızda ardışık SCUBA dalışlarının küçük hava yollarında daralmaya yol açtığı ancak büyük hava yolları ve akciğer hacimlerine bir etkisi olmadığı saptanmıştır. Eğlence amaçlı yapılan SCUBA dalışlarının etkilerini inceleyen araştırmalar oldukça az olup genellikle deneyimli dalıcılarda birikici etki konu alınmıştır. Bu çalışma kısa dönemde etkileri göstermesi açısından literatürdeki tek örnek olması nedeniyle önemlidir. Etkinin ne kadar süre devam ettiği ya da normal değerlere dönme eğilimi ileri çalışmalar ile araştırılmalıdır.

TEŞEKKÜR

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KAYNAKÇA

Agostoni E, Gurtner G, Torri G, et al. (1966). Respiratory mechanics during submersion and negative-pressure breathing. J Appl Physiol; 21: 251–258.

Diniz CM, Farias TL, Pereira MC et al. (2014). Chronic adaptations of lung function in breath-hold diving fishermen. Int J Occup Med Environ Health, 27: 216–223.

Lemaître F, Tourny-Chollet C, Lemouton MC. (2006) Ventilatory functions in exprienced recreational scuba diver: Evidence of small airways disease? Int J Sports Med, Nov;27(11):875-9

Pougnet R, Pougnet L, Lucas D, Uguen M, Henckes A et al. (2014). Longitudinal change in professional divers' lung function: literature review. Int Marit Health, 65, 4: 223–9 DOI: 10.5603/IMH.2014.0042

Sames C, Gorman DF, Mitchell SJ, et al. (2009). The long-term effects of compressed gas diving on lung function in New Zealand occupational divers: a retrospective analysis. Diving Hyperb Med, 39: 133–137. 69

Sames C, Gorman DF, Mitchell SJ, Zhou L. (2018). Long term changes in spirometry in occupational divers: a 10-25 year audit. Diving Hyperb Med, 3:10-16

Sports and Fitness Industry Association (2015). Participation in recreational diving report, USA

Tetzlaff K, Theysohn J, Stahl C, Schlegel S, Koch A, Muth CM. (2006) Decline of FEV1 in scuba divers. Chest, 130: 238–243

Tetzlaff K, Thomas PS. (2017). Short- and long-term effects of diving on pulmonary function. Eur Respir Rev, 26:160097

Thom SR, Milovanova TN, Bogush M et al. (2012). Microparticle production, neutrophil activation, and intravascular bubles folloeing open-water SCUBA diving. J Appl Physiol, 112: 1268-78

Thorsen E, Segadal K, Stuhr LEB et al. (2006). No changes in lung function after a saturation dive to 2.5 MPa with intermittent reduction in PO2during decompression. Eur J Appl Physiol, 98: 270-5

Tipton MJ. (2016). Environmental extremes: origins, consequences, and amelioration in humans. Exp Physiol, 101: 1-14

Uhlig F, Muth CM, Tetzlaff K, et al. (2014). Lung function after cold-water dives with a standard scuba regulator or full-face-mask during wintertime. Diving Hyperb Med, 44: 70–73

Van Ooij PJ, Hollmann MW, van Hulst RA, Sterk PJ. (2013). Assessment of pulmonary oxygen toxicity: relevance to professional diving; a review. Respir Physiol Neurobiol, 189: 117–128

Voortman M, Van Ooij PJAM, van Hulst RA et al. (2016). Pulmonary function changes in Navy divers during their Professional careers. Undersea Hyberb Med, 43: 649-57

Warkander, D.E., Nagasawa GK, Lundgren CE. (2001). Effects of inspiratory and expiratory resistance in divers' breathing apparatus. Undersea Hyperbaric Medicine, 28(2):63-73.

Wilson A. (2011). Prevalence and characteristics of lung function changes in recreational scuba divers. Prim Care Respir J, 20: 59–63

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