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The Effect of the Interval Training During 8-Week Preparation Period on the Athletic Performances of 9-12 Year Old Swimmers

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Abstract

The aim of this study was to determine the effect of interval training on the athletic performances of 9-12 years old swimmers in addition to the eight-week preparation stage. Athletes were split into two groups as the ones with performing branch specific swimming training (n=9) and the ones with performing interval training along with swimming training (n=11). Before and after training programs, 12-minutes Cooper test was applied to determine aerobic endurance in both groups. Wingate test was used for anaerobic measurements. Respiratory functions measurements were done with Spirometer. According to the results, level of body weight, body mass index, VO_{2max}, relative maximum strength, relative anaerobic capacity, forced vital capacity and maximum voluntary ventilation was found to be insignificant between groups ($p>0.05$) while vital capacity and forced expiratory volume values were found to be significant between groups ($p<0.05$). Two-way analysis of variance was used in statistical analysis of the data obtained in this study. When measurement times were compared, body weight, forced vital capacity, forced expiratory volume, vital capacity and maximum voluntary ventilation values were found as insignificant ($p>0.05$), yet body mass index, VO_{2max}, relative maximum force and relative anaerobic capacity levels were found to be significant ($p<0.05$). In conclusion, while body mass of athletes was reduced by 3.55% with interval training made in addition to swimming training, increase in forced vital capacity and forced expiratory volumes of athletes were determined as 1.35% and 8.79%, respectively. This result shows that interval training performed during preparation stage affect the performance of child athletes.

Keywords: Interval training, aerobic endurance, anaerobic capacity, anaerobic force, respiratory functions

Introduction

Trainers, conditioning coaches, and sports scientists are constantly searching new training methods to improve the performance of athletes (Issurin, 2010). Searching is usually aimed to improve aerobic capacity because improving aerobic capacity requires substantially long time and hard effort (Akgul et al., 2017). The American College of Sports Medicine (ACSM) (2011) reports that at least 45-50 minutes of endurance training per each session and repeated at least 3 times per week for 8 to 12 weeks is required for aerobic capacity development.

Continuous endurance training increase performance in aerobic energy metabolism-based functions. Gibala (2007) reported that high-intensity interval training (HIIT), which has been adequately applied for at least a few weeks, increases oxygen uptake and activity of energy-producing mitochondrial enzymes in skeletal muscles. Therefore, interval training methods are one of the most effective performance improving the method. Interval training means repetition of various training at regular intervals. Characteristic of interval training is the systematical changes in training and recovery (Revan et al., 2008). The recovery here does not mean a complete rest. Therefore, it means enhancing fatigue resistance in order to improve the capacity of the intended endurance performance in the training (Demiriz, 2013).

In swimming, moves made out of water called “land training” and the purpose is to improve athlete’s physical suitability. Land training should be performed before water training that should also support land training. Land training can be performed with athlete’s own body weight or use various special equipment (Devirmenci and Karacan, 2017). In this context, the purpose of this research is to demonstrate the effect of basic strength (running) training, performed on the land during the general training period, on the athletic performance parameters of the 9-12 age swimmers, except for the general endurance work in the pool during the general preparation period.

Materials and Methods

Participants

22 voluntary athletes from Gazi University Sports club swimming team participated in the study. Participants were randomly split into two groups. Experimental group practiced interval training in addition to pool training while control group practiced routine pool training. The study was completed with 20 volunteers due to quitting of two participants in the control group.

Measurement methods and tests

All tests were carried out at Gazi University Physical Education and Sports College, Physiology Laboratory and Gazi University Sports Club football field. The athletes and their parents were given preliminary information about the measurement methods and tests to be applied to the study groups, and a voluntary consent form was obtained.

Height and weight measurement

The height of the subjects (m) was measured with an anthropometric set (Holtain brand), with bare feet, legs flat on the ground, heels adjacent, knees tense, and body in a vertical position with a sensitivity of 1 mm. Body weight (kg) was measured with bare feet, shorts, and T-shirt using an electronic scale (Tefal brand) with a setting accuracy of 100 gr.

Determination of maximum heart rates

Maximum heart rates of all participants were measured with using Karvonen method. Target pulse is calculated as [((220 - Resting pulse) - age)*intensity of training + resting pulse]

Aerobic capacity

It is asked from groups to run the longest distance that can last for 12 minutes at the beginning and end of an 8-week training period. Every running lap of athletes was recorded. The formula to determine aerobic capacity in 12-minutes Cooper test is as follows: VO_{2max}: (Running distance (m) - 504.9)/44.73

Anaerobic strength

Wingate (Monark Wingate Testing Ergometer 849E) anaerobic strength test was applied to the participants as preliminary and final test in Gazi University Physical Education and Sports College, Physiology Laboratory. The maximum anaerobic power and mean anaerobic power obtained at the end of the test were divided by body weight and the results were recorded as relative anaerobic strength and relative anaerobic capacity.

Respiratory functions measurements

(COSMED Pony FX Desktop Spirometer) device was used to measure respiratory functions to the participants as preliminary and final test in Gazi University Physical Education and Sports College, Physiology Laboratory. Forced vital capacity (FVC), forced expiratory volume (FEV), vital capacity (VC) and maximum voluntary ventilation (MVV) values were recorded from the data obtained.

Experimental design

Groups trained for 6 days per week in order to equate the number of training. Experimental groups practiced swimming training for three days and practiced running interval training at 60-80% intensity following three days while control group practiced routine swimming training for six days. Athlete’s heart rates intervals were personally determined and their heart rates were kept at reference interval using polar watches. Eight week-long interval training in addition to routine swimming training were given to experimental group were shown in the table below.

<table>
<tr><th>Distance/Week</th><th>1-2 week</th><th>3-6 week</th><th>7-8 week</th></tr>
<tr><td>250 m</td><td rowspan="7">-1 min active rest was provided between distances.

-One set was done.

-Cooling exercise was done for 5-10 min.</td><td rowspan="7">-1 min active rest was provided between distances.

-2 sets were done

-Cooling exercise was done for 5-10 min.</td><td rowspan="7">-1 min active rest was provided between distances

-3 sets were done.

-Cooling exercise was done for 5-10 min.</td></tr>
<tr><td>400 m</td></tr>
<tr><td>650 m</td></tr>
<tr><td>900 m</td></tr>
<tr><td>650 m</td></tr>
<tr><td>400 m</td></tr>
<tr><td>250 m</td></tr>
</table>

Statistical Analysis

Data were analyzed using SPSS package software. Percentage difference between measurement times was calculated using the formula: "Δ%= (Final test – Preliminary Test)/Preliminary Test × 100" and Two-way analysis of variance (Group X Time) were used to compare the data obtained in this study. Confidence interval and significance level were determined as 95% and $p<0.05$, respectively.

Results

The average age of the athletes participating in the experimental group was determined as 10.64± 0.51 years and their average height was 150.55±7.34 cm. The mean age of the control group was determined as 10.78± 0.44 years and the mean height as 153.67±7.04.

Table 1. Comparison of body weight values based on different training types and measurement times.

Variables	N	Preliminary test (kg)	Final Test (kg)	Total	F	p
		$\bar{X}\pm$ SS	$\bar{X}\pm$ SS	$\bar{X}\pm$ SS		
Experimental Group	11	40.82±8.84	39.27±8.63	40.05±2.30	0.118	0.735
Control Group	9	40.44±5.81	42.00±6.24	41.22±2.54		
Total	20	40.65±7.44	40.50±7.58			
		F=0.000; p=0.987				

***p<0.001; kg: kilogram*

When Table 1 was examined, it was determined that mean values of preliminary test and final test body weights did not show any statistical significance with time ($F=0.000$; $p=0.987$). Furthermore, body weight values did not show statistical significance compared to training types ($F=0.118$; $p=0.735$). Additionally, interaction between training types and measurement times were found to be significant ($F=26.004$; $p=0.001$). Accordingly, it is found that body weights' mean of experimental group decreased by 3.55% and body weights' mean of control group increased by 3.32%.

Table 2. Comparison of Body Mass Index values based on different training types and measurement times.

Variables	N	Preliminary test (kg/m^2)	Final Test (kg/m^2)	Total	F	P
		$\bar{X} \pm SS$	$\bar{X} \pm SS$	$\bar{X} \pm SS$		
Experimental Group	11	18.21±2.45	17.70±2.35	17.96±0.63	0.317	0.580
Control Group	9	17.46±1.74	17.40±1.53	17.43±0.69		
Total	20	17.87±2.14	17.57±1.98			
F=5.389; p=0.032*						

**p<0.05; kg: kilogram; m: meter*

When Table 2 was examined, it was determined that mean values of preliminary test and final test body mass index showed statistical significance with time (F=5.389; p=0.032). Moreover, body mass index values did not show statistical significance compared to training types (F=0.317; p=0.580). Also, the interaction between training types and measurement times were found to be insignificant (F=3.477; p=0.079).

Table 3. Comparison of Aerobic endurance (VO_{2max}) values based on different training types and measurement times.

Variables	N	Preliminary test (ml/kg/min)	Final Test (ml/kg/min)	Total	F	p
		$\bar{X} \pm SS$	$\bar{X} \pm SS$	$\bar{X} \pm SS$		
Experimental Group	11	39.12±5.90	42.97±4.25	41.05±1.64	0.687	0.418
Control Group	9	37.64±6.15	40.39±6.33	39.02±1.82		
Total	20	38.45±5.90	41.81±5.30			
F = 23.295; p = 0.001 **						

***p<0.01; ml: milliliter; kg: kilogram; min: minute*

When Table 3 was examined, it was determined that mean values of preliminary test and final test VO_{2max} showed statistical significance with time (F=23.295; p=0.001). Besides, VO_{2max} values did not show statistical significance compared to training types ((F=0.687; p=0.418) In addition to that, interaction between training types and measurement times were not found to be significant (F=0.650; p=0.431).

Table 4. Comparison of Relative anaerobic strength (Relative peak strength) values based on different training types and measurement times

Variables	N	Preliminary test ($W \times kg^{-1}$)	Final Test ($W \times kg^{-1}$)	Total	F	p
		$\bar{X} \pm SS$	$\bar{X} \pm SS$	$\bar{X} \pm SS$		
Experimental Group	11	7.32±1.03	7.73±1.05	7.53±0.36	2.359	0.142
Control Group	9	7.85±1.44	8.84±1.46	8.34±0.39		
Total	20	7.56±1.23	8.23±1.34			
F=17.428; p=0.001**						

$^{**}p<0.01$; W: Watt; kg: kilogram

When Table 4 was analyzed, it was determined that mean values of preliminary test and final test of relative anaerobic strength values showed statistical significance with time (F=17.428; p=0.001). Furthermore, relative anaerobic strength values did not show statistical significance compared to training types (F=2.359; p=0.142). Additionally, interaction between training types and measurement times were found to be insignificant (F=3.025; p=0.099).

Table 5. Comparison of Relative anaerobic capacity (Relative mean strength) values based on different training types and measurement times

Variables	N	Preliminary test ($W \times kg^{-1}$)	Final Test ($W \times kg^{-1}$)	Total	F	p
		$\bar{X} \pm SS$	$\bar{X} \pm SS$	$\bar{X} \pm SS$		
Experimental Group	11	5.62±0.70	5.99±0.83	5.81±0.26	3.251	0.088
Control Group	9	6.12±1.01	6.87±1.02	6.50±0.28		
Total	20	5.85±0.87	6.38±1.00			
F=25.969; p=0.001**						

$^{**}p<0.01$; W: Watt; kg: kilogram

When Table 5 was analyzed, it was determined that mean values of preliminary test and final test of relative anaerobic capacity values showed statistical significance with time (F=25.969; p=0.001). Further, relative anaerobic capacity values did not show statistical significance compared to training types (F=2.359; p=0.142). Additionally, the interaction between training types and measurement times were found to be insignificant (F=3.059; p=0.097).

Table 6. Comparison of Forced vital capacity values based on different training types and measurement times

Variables	N	Preliminary test (L/Sec)	Final Test (L/Sec)	Total	F	p
		$\bar{X} \pm$ SS	$\bar{X} \pm$ SS	$\bar{X} \pm$ SS		
Experimental Group	11	2.21±0.38	2.24±0.46	2.23±0.12	5.796	**0.027***
Control Group	9	2.64±0.47	2.67±0.36	2.66±2.38		
Total	20	2.42±0.46	2.42±0.47			
F=0.000; p=0.999						

**p<0.05; L:Liters; Sec:Second*

When Table 6 was analyzed, it was determined that mean values of preliminary test and final test of forced vital capacity values were insignificant with time (F=0.000; p=0.999). Further, forced vital capacity values showed statistical significance compared to training types (F=5.796; p=0.027). Hence, increase in forced vital capacity in experimental groups was 1.35% higher compared to control group. In addition to this, the interaction between training types and measurement times were found to be insignificant (F=0.279; p=0.604).

Table 7. Comparison of forced expiratory volume values based on different training types and measurement times

Variables	N	Preliminary test (L/Sec)	Final Test (L/Sec)	Total	F	p
		$\bar{X} \pm$ SS	$\bar{X} \pm$ SS	$\bar{X} \pm$ SS		
Experimental Group	11	2.16±0.32	2.35±0.40	2.26±0.12	5.980	**0.025***
Control Group	9	2.55±0.47	2.61±0.39	2.58±0.13		
Total	20	2.34±0.43	2.35±0.45			
F=0.329; p=0.573						

**p<0.05; L:Liters; Sec:Second*

When Table 7 was analyzed, it was determined that mean values of preliminary test and final test of forced expiratory volume values were insignificant with time (F=0.329; p=0.573). Moreover, forced expiratory volume values showed statistical significance compared to training types (F=5.980; p=0.025). Therefore, increase in forced expiratory volumes in the experimental group was higher (8.79%) than the control group. Additionally, interaction between training types and measurement times were found to be insignificant (F=0.853; p=0.368).

Table 8. Comparison of vital capacity values based on different training types and measurement times

Variables	N	Preliminary test (L/Sec)	Final Test (L/Sec)	Total	F	p
		$\bar{X} \pm$ SS	$\bar{X} \pm$ SS	$\bar{X} \pm$ SS		
Experimental Group	11	1.82±0.48	1.92±0.59	1.87±0.15	1.607	0.221
Control Group	9	2.11±0.41	2.21±0.76	2.16±0.17		
Total	20	2.01±0.45	2.00±0.68			
F=0.000; p=0.986						

L: Liter; Sec: Second

When Table 8 was examined, it was determined that mean values of preliminary test and final test of vital capacity values showed no statistical significance with time (F=0.000; p=0.986). Furthermore, forced expiratory volume values did not show statistical significance compared to training types (F=1.607; p=0.221). Additionally, the interaction between training types and measurement times were found to be insignificant (F=0.682; p=0.420).

Table 9. Comparison of maximum voluntary ventilation values based on different training types and measurement times

Variables	N	Preliminary test (L/Sec)	Final Test (L/Sec)	Total	F	p
		$\bar{X} \pm$ SS	$\bar{X} \pm$ SS	$\bar{X} \pm$ SS		
Experimental Group	11	78.98±19.85	95.96±17.07	87.47±6.02	2.971	0.362
Control Group	9	90.06±22.04	100.67±23.65	95.36±6.66		
Total	20	83.97±21.07	87.08±23.40			
F=18.000; p=0.100						

***p<0.01; L: Liter; Sec: Second*

When Table 9 was examined, it was determined that mean values of preliminary test and final test of maximum voluntary ventilation values showed no statistical significance with time (F=18,000; p=0.100). Moreover, maximum voluntary ventilation values did not show statistical significance compared to training types (F=3,971; p=0.062). Additionally, interaction between training types and measurement times was found to be significant (F=18.000; p=0.006). Therefore, maximum voluntary ventilation is a variable that can change based on training types and durations.

Discussion and Conclusion

The main purpose of this study was to investigate whether there is an effect of interval training in addition to eight-week preparation stage swimming training on athletic performances of 9-12 years old swimmers.

Longitudinal studies in literature reported that when body weight values before training program and the values after training are compared, decrease ($p<0.01$) and increase ($p<0.05$) in body weights were found to be significant (Al Abdilh and Savas, 2017; Koc, 2010; Yuksel et al., 2007; Kiyici, 2009). Al-Abdilh and Savas (2017) reported that the Body Mass Index variable was statistically different from the results of the different type of endurance training measurements applied to young basketball players. Demirel et al. (2017) found that there was no statistical difference between body mass index values of experimental and control groups in their study which consists of elite wrestlers for examining the effect of aerobic and anaerobic training program on body composition. Gokhan et al. (2011) found that there was no significant difference between preliminary test values (25.2±3.3 kg/m2) and final test values (24.3±2.8 kg/m2). Yapici et al. (2017) reported in their study that the analysis of preliminary and final test values of the group performing the training with liquid fortification did not yield a statistically significant result in the body mass index; The results of the analysis of the preliminary and final test values of the group performing the training without receiving liquid fortification have reached a statistically significant results. According to experimental results, it was identified that body weight mean of experimental group decreased by 3.55%, meanwhile mean body weight of control group increased by 3.32%. Additionally, there was no significant difference between mean body mass indexes ($p>0.05$).

Cimen et al. (2017) have reported that regular and gradually increasing intensity of aerobic training can increase VO_{2max} levels. Revan (2007) found that whenVO_{2max} values were compared before and after regular training, there were statistically significant differences in groups with performing continuous and interval running, yet control groups Akgul et al. (2016) observed significant increases in VO_{2max} (4.44%), VO_{2peak} (8.09%) and exhaustion period (7.4%) at the end of 2 weeks. Moreover, Revan et al. (2008) found that the continuous running method is more effective than the interval running method in decreasing body weight, and both methods show similar positive effects in decreasing body fat percentage and improving aerobic capacity in the 8-week study they performed. According to our results, even though significant difference detected between measurement times of eight week-long training, there was no significant difference between groups.

Calculation of anaerobic strength and capacity per kg provides more reliable comparison in evaluation among individuals. Anaerobic strength and capacity values of participants who enrolled in this study were compared. Although the significant difference between measurement times of eight week-long training was detected, there was no significant difference between groups. Alemdaroglu et al. (2008) found no statistically significant difference between peak strength (PS) and mean strength (MS) in values of strength variables obtained from WanT. Colakoglu and Karacan (2016) found a statistically significant increase in anaerobic strength values of young and middle-aged women. In another study, they reported that 12-week table tennis practice made a significant difference in anaerobic strength values (Akgon and Agirbas, 2015). In the study performed by Erim (2006) to examine the effect of certain parameters on the performance of 8-week rapid-force and weighted training programs in the male table tennis players, it was found that there was no significant increase in the anaerobic strength values of both groups. Demiriz et al. (2015) reported improved anaerobic capacities in the study named as the effect of anaerobic interval training in different resting intervals on aerobic capacity, anaerobic threshold, and blood parameters.

Atan et al. (2013) reported that swimmers had the best forced vital capacity values compared to other branches in their study that compares respiratory functions of athletes who deals with other branches in star categories (Atan et al., 2013). Gokhan et al. (2011) found that measurement of forced vital capacity values in final test significantly increased in respect to before training measurements when measured values after training compared with measured values before training in an experimental group. Increase in forced vital capacity values was significant when the first measurement before training compared to the second measurement after training in the study which investigated the effect of Koc (2010) aerobic training program on some circulation and respiratory parameters in male handball players (Koc, 2010). Gokdemir et al. (2007) found increased forced vital capacity in first minutes ($p<0.01$) when measured values before training compared statistically to measured values after training. Gokdemir and Koc reported that forced vital capacities (from 4.60±0.45 to 5.26±0.69) were increased as a result of general endurance training which was applied three times a week for eight weeks. We found significant differences between groups in our study. Accordingly, forced vital capacity of the experimental group (1.35%) is higher compared to control group after eight-week-long training.

Koc (2010), increase in forced expiratory volume values in the first minute was found to be significant when results of the first measurement before training compared to results of the second measurement after training. Gokdemir et al. (2007) identified statistical significance between measurements before training and measurements after training. Gokhan et al. (2011) observed that forced expiratory volume values of the final test in the first minute significantly increased with respect to measurements before training when test measurements after training (final test) compared to test measurements before training (preliminary test) in the experimental group. According to results, a significant difference was observed between groups. Therefore, increase in forced expiratory volumes in the experimental group was higher (8.79%) than the control group.

Bjurstrom and Schoene (1987) reported that vital capacities of swimmers were found to be quite high when vital capacities of the experimental group consisting of elite swimmers compared to control group. Koc (2010) reported a significant increase in vital capacities when the result of the first measurement before training compared to the result of the second measurement after training. Koc and Gunay (2000) found a significant increase in vital capacity values as a result of general speed training program they applied for three days in a week for eight weeks. Iri (2000) reports an increase in respiratory parameters due to aerobic training programs over a period of time. Kurkcu et al. (2009) reported that the difference in respiratory function values was insignificant in the study they conducted in order to determine the effect of pre-season preparatory training for eight weeks. According to our results, there was no significant difference between study groups and measurement times. This result indicates that there is no difference in the context of improving vital capacity between trainings.

Kandeydi (1994) found that the maximum voluntary ventilation value of university students was significantly higher at the end of 3-month swimming training. In another study, Kurkcu and Gokhan (2011) found maximum voluntary ventilation measurement values of handball player kids were 799.40 ± 130.17 L/min while maximum ventilation measurement values of kids who do not do sports were 611.55 ± 23.16 L/min. The difference in maximum voluntary ventilation measurement values was found to be significant between groups. According to results, there was no significant difference between groups and measurement times

Kubiak and Janczaruk (2005) reported a statistically significant difference between vital capacity, forced expiratory volume, and forced expiratory volume at the first minute of preliminary test and final test values at the end of a six-month study with 310 elite swimmers aged 12-14 years.

In conclusion, while body mass of athletes was reduced by 3.55% with interval training made throughout swimming training, increase in forced vital capacity and forced expiratory volumes of athletes were determined as 1.35% and 8.79% respectively. This result shows that interval training performed during preparation stage affect the performance of child athletes.

According to the results, it is suggested that swimmers exercise resistance training on land, especially during the preparation periods, in addition to the exercises practiced in water. Thus, it is thought that the swimmers will have a positive effect on their athletic performances

Conflict of Interest

The authors have not declared any conflicts of interest.

REFERENCES

Aggön E, Agırbas Ö (2015). 12 haftalık masa tenisi antrenmanlarının vücut kompozisyonu, anaerobik performans ve kas kuvveti üzerine etkisi. *İnönü Üniversitesi, Beden Eğitimi ve Spor Bilimleri Dergisi,* 2(2), 12-20

Akgul MS, Gürses VV, Karabıyık H, Koz M (2016). İki haftalık yüksek şiddetli interval antrenmanın kadınların aerobik göstergeleri üzerine etkisi. *International Journal of Science Culture and Sport (IntJSCS),* 4:(SI 1): 298-305

Akgul SA, Koz M, Gürses VV, Kurkcu R (2017). Yüksek şiddetli interval antrenman. *Spormetre*, *15*(2), 39-46.

Al Abdilh W, Savas S (2017). Genç erkek basketbolculara farklı tipte uygulanan dayanıklılık antrenmanlarına fizyolojik tepkiler. *Gazi Journal of Physical Education and Sport Sciences,* 22(1-4), 11-24.

Alemdaroglu U, Koklu Y, Arslan E, Karakoc B (2008). Farklı seviyedeki liglerde oynayan takımların altyapısında mücadele eden genç futbolcularda supramaksimal bacak egzersizi yanıtlarının karşılaştırılması. *Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi*, 6(1): 21 – 25.

American College of Sports Medicine (2011). Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal and neuromotor fitness in apparently healthy adults. Med. Sci. Sports, 22-265.

Atan T, Akyol P, Cebi M (2013) Comparison of respiratory functions of athletes engaged in different individual sports branches. *Dicle Medical Journal,* 40(2):192-8.

Bjurström RL, Schoene RB (1987). Control of ventilation in elite synchronized swimmers. *J Appl Physiol*, 63(3):1019-24.

Cimen O, Cicioğlu İ, Gunay M (1997). Erkek ve bayan türk genç milli masa tenisçileri fiziksel ve fizyolojik profilleri. *Beden Eğitimi ve Spor Bilimleri Dergisi,* ss53.

Colakoğlu FF, Karacan S (2006). Genç bayanlar ile orta yaş bayanlarda aerobik egzersizin bazı fizyolojik parametrelere etkisi. *Kastamonu Eğitim Dergisi*, 14(1): 277 – 284.

Demirel N, Ozbay S, Kaya F, Bayram M (2017). The effects of aerobic and anaerobic training programs applied to elite wrestlers on body composition. *International Journal of Social Sciences and Education Research,* Volume: 3(2).

Demiriz M, Erdemir İ, Kayhan RF (2015). Farklı dinlenme aralıklarında yapılan anaerobik interval antrenmanın, aerobik kapasite, anaerobik eşik ve kan parametreleri üzerine etkileri. *UluslararasıSpor, Egzersiz ve Antrenman Bilimi Dergisi,* Cilt 1, Sayı 1, 1-8.

Deyirmenci HS, Karacan S (2017). The effects of 12-weeks thera-band training on swimming performance at 11-13 age group swimmers 11-13 yaş grubu erkek yüzme sporcularında 12 haftalık terabant antrenmanının yüzme performansına etkileri. *Journal of Human Sciences*, 14(4), 4958-4968.

Erim V (2006). 16-18 yaş grubu erkek masa tenisçilerde teknikle bağlantılı kuvvette devamlılık antrenmanlarının bazı fizyolojik ve fiziksel parametreler üzerine etkisinin incelenmesi, Gazi Üniversitesi Sağlık Bilimleri Enstitüsü Beden Eğitimi ve Spor Anabilim Dalı, Yüksek Lisans Tezi, Ankara, s: 18-26

Gibala MJ, Ballantyne C (2007). High-intensity interval training: New insights. *Sports Science Exchange*, *20*(2), 1-5.

Gokdemir K, Koc H (2000). Hentbolcularda genel kuvvet antrenman programının bazı fizyolojik parametrelere etkisi. *Gazi Üniversitesi Ulusal Spor Bilimleri Kongresi.*

Gokdemir K, Koc H, Yuksel O (2007). Aerobik antrenman programının üniversite öğrencilerinin bazı solunum ve dolaşım parametreleri ile vücut yağ oranı üzerine etkisi. Egzersiz. 1(1):44-49.

Gokhan I, Kurkcu R, Devecioglu S, Aysan HA (2011). Yüzme egzersizinin solunum fonksiyonları, kan basıncı ve vücut kompozisyonu üzerine etkisi. *Klinik ve Deneysel Araştırmalar Dergisi,* 2(1): 35 – 41

Iri R (2000). Amatör futbolcularda makro dönem dayanıklılık antrenmanının aerobik, anaerobik kapasite ve dolaşım, solunum sistemlerine etkisi. Sakarya Üniversitesi Sosyal Bilimler Enstitüsü. Yüksek lisans tezi.

Issurin VB (2010): New horizons for the methodology and physiology of training periodization Sport Med, 40(3), 189-206.

Kandeydi O (1994). Düzenli yüzme antrenmanı yapan üniversite öğrencilerinde görülen fizyolojik değişiklikler, yüksek lisans tezi, İzmir.

Kıyıcı F (2009). Sıcak ortamda yapılan iki farklı dayanıklılık antrenmanının bazı fiziksel, fizyolojik ve kan parametreleri üzerine etkileri. Doctoral thesis Ankara. Gazi University

Koc H (2010). Aerobik antrenman programının erkek hentbolcularda bazı dolaşım ve solunum parametrelerine etkisi. *Selçuk Üniversitesi Beden Eğitimi ve Spor Bilim Dergisi*, 12(3):185 – 190.

Koc H, Gunay M (2000). Sekiz haftalık genel sürat antrenman programının hentbolcularda vücut yağ yüzdesi, solunum fonksiyonları ve kan basıncına etkisi. *Gazi Üniversitesi Ulusal Spor Bilimleri Kongresi*.

Kubiak-Janczaruk E (2005). Spirometric evaluation of the respiratory system in adolescent swimmers. *Ann Acad Med Stetin,* 51(2):105-13.

Kurkcu R, Gokhan I (2011). Hentbol antrenmanlarının 10 – 13 yaş grubu öğrencilerin bazı solunum ve dolaşım parametreleri üzerine etkileri. *Uluslararası İnsan Bilimleri Dergisi,* 8(1): 135 – 143.

Kurkcu R, Hazar F, Atlı M, Kartal R (2009). Sezon öncesi hazırlık dönemi antrenmanlarının güreşçilerin solunum fonksiyonları, kan basıncı ve vücut kompozisyonuna etkisi. *Türkiye Kick Boks Federasyonu Spor Bilimleri Dergisi*, 1(2): 9 – 19.

Revan S, Balcı SS, Pepe H, Aydogmuş M (2008). Sürekli ve İnternal Koşu Antrenmanlarının Vücut Kompozisyonu ve Aerobik Kapasite Üzerine Etkileri, *Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi*, 5 (4): 193–197.

Yapıcı A, Kavruk H, Celik E (2017). Yüzücülerde eşik dayanıklılık antrenmanı (end-2) sonucunda oluşan dehidrasyonun performans üzerine etkileri ve vücut hidrasyon düzeyinin incelenmesi. *International Journal of Cultural and Social Studies (IntJCSS), December*, 3 (SI): 372-381.

Yüksel O, Koc H, Ozdilek C, Gokdemir K (2007). Sürekli interval antrenman programlarının üniversite öğrencilerinin aerobik ve anaerobik gücüne etkisi. *Sağlık Bilimleri Dergisi,* 16(3):133 – 139.