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Investigation of the effect of fartlek training on aerobic performance in adolescent female basketball players

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Abstract

This study was conducted to determine the effects of fartlek training on running distance and maximal oxygen consumption capacity (VO_2 max) in female basketball players. There were 21 participants in the experimental group (N:12, mean age:14.83 years) and control group (N:9, mean age:14.83years). In this practice, a two-group pretest-posttest model was used. In this study, the experimental group performed running exercises using the Fartlek method on hilly terrain for 8 weeks, while the control group performed aerobic training on flat terrain. In addition to measurements of body weight (BW), height, and body mass index (BMI), athletes underwent measurements of the Balke treadmill test and VO_2max. SPSS 22 program was used for statistical analysis and G*Power program was used for sample size determination. As a result of the analysis, it was found that 18 participants would be sufficient. It was found that the data given in the study did not show the normal distribution and Wilcoxon signed-ranks test was used in the pre-test and post-test comparison and the Mann Whitney-U test was used in the comparison of the averages of two different groups. As a result of the measurements, it was found that running distance and maximum oxygen consumption capacity (VO_2max) in the experimental group were significantly in favour of the posttest, while body weight (BW) and body mass index (BMI) in the control group showed a significant decrease after the posttest compared to pretest values ($p<0.005$). At the end of the study, it was concluded that fartlek exercises led to a significant increase in running distance and (VO_2 max) measurements and had a positive effect on endurance parameters in female basketball players.

Keywords: Adolescence female, basketball players, fartlek training, VO_2max

Fartlek egzersizlerin adölesan kız basketbolcularda aerobik performans üzerine etkisinin araştırılması

Öz

*Araştırmamız Fartlek antrenmanların kız basketbolcularda koşu mesafesi ve maksimal oksijen tüketim kapasitesi (VO_2max) etkisini tespit etmek amacıyla yapılmıştır. Araştırmamıza çalışma grubu (n:12, yaş ort:14,81) ve kontrol grubu (n=9, yaş ort:14,83) olmak üzere 21 kişi katılmıştır. Çalışmamız da iki grup ön-test son-test modeli kullanılmıştır. Araştırmamızda çalışma grubuna 8 hafta fartlek yöntemi ile koşu egzersizleri yaptırılırken; kontrol grubuna aerobik antrenmanlar uygulanmıştır. Araştırmada sporculardan vücut ağırlığı (VA), boy (cm), beden kütle indeksi (BKI) ölçümlerine ek Balke koşu bandı testi ve VO_2max ölçümleri alınmıştır. İstatiksel analizde SPSS 22 programı; örneklem büyüklüğü tespiti için ise G*Power kullanılmıştır. Analiz sonucunda (g:03, α:0,05, β:0,85)18 katılımcının yeterli olacağı bulgusuna ulaşılmıştır. Verilen normal dağılım göstermediği bulgusuna ulaşılmış ve ön test son test karşılaştırılmasında Wilcoxon işaretli sıralar testi; iki farklı grubun ortalamalarının karşılaştırılmasında ise Mann Whitney-U testi kullanılmıştır. Ölçümler sonucunda çalışma grubunda koşu mesafesinde ve maksimal oksijen tüketim kapasitesi (VO_2max) son test lehine anlamlı olduğu, kontrol grubunda ise VA, BKI son test değerlerinin ön test değerlerine göre anlamlı düzeyde azalış gösterdiği bulgusuna ulaşılmıştır ($p<0,05$). Grup ortalamaları karşılaştırıldığında; koşu mesafesi ve VO_2max 2. ölçümlerde anlamlı farklılaşma olduğu bulgusuna ulaşılmıştır ($p<0,05$). Araştırma sonunda fartlek egzersizlerin kız basketbolcularda koşu mesafesi ve VO_2max ölçümlerinde anlamlı artışlar olduğu ve dayanıklılık parametrelerine pozitif etki yaptığı sonucuna ulaşılmıştır.*

Anahtar Kelimeler: *Adolesan kızlar, basketbol, fartlek antrenman, VO_2max*

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INTRODUCTION

Basketball is a sport branch in which both male and female athletes compete in national and international organizations, requiring a high level of performance, in which athletes exhibit their basic motoric characteristics in a dynamic progress game, where physical elements are effective in winning matches as well as technical skills (Sutanto, 2016; Vasconcelos et al., 2017). For these reasons, it is stated that it is important to make physical, cognitive, technical, and tactical training programmed for basketball players during the preparation and competition period and to monitor the development of athletes (Ziv & Lidor, 2009). Coaches apply various training methods to athletes to improve the performance of athletes with athletic performance trainer (Puente et al., 2017). One of these training methods is fartlek running exercises that improve the endurance characteristics of athletes. Fartlek exercises are effective in increasing the strength and aerobic capacity of athletes and have many different methods (Jones, 2016). Fartlek running exercises; It is applied in open and hilly areas and the tempo continues fast and slow during running. Fartlek exercises, which are designed according to the level of athletes, determine the aerobic capacity of the participants. Fartlek exercises provide progress in the aerobic threshold level and performance increases progress visibly (Bompa, 1999).

Maximal oxygen consumption capacity is an indicator of the aerobic capacity of athletes. In other words, it is defined as the amount of oxygen used to maintain the highest level of oxidative Adenosine Triphosphate (ATP) production according to the ability of the heart to transport oxygen to the working muscles (Levine, 2008). It is stated that maximum oxygen consumption is the condition in which there is no increase in oxygen intake despite an increase in the intensity of exercise (George et al., 2009).

There are no more studies that test this parameter in adolescent girls' basketball players to investigate aerobic capacity. The aim of this study determines the effect of fartlek exercises performed 2 days a week for 8 weeks on aerobic running performance and VO_2max level in female basketball players who participated in basketball competitions for at least 4 years. This study is thought to contribute to the literature in terms of quantity.

METHOD

Research group (population-sample)

The sample group of that study consisted of competitive basketball players in the experimental group (N=12, age=14.83^{years}, height=168.4^{cm}, BW=61.44^{kg}) and the control group (N=9, age=14.83^{years}, height=165.41^{cm}, BW=60.22^{kg}). This study used two groups and received a pre-posttest. Before the study, a meeting was held with the participants and their parents, and

they were informed about the content of the study. In this voluntary study, a detailed consent form was signed by the parents. This study was designed according to the Helsinki Declaration. This study ethics committee report was received University of Siirt. Date:26.04; issue:70492 issue.

Data collection tools

Height, Body Weight, and Body Mass Index Measurements*;* Mesilife Brand (130-200^{cm} capacity, 1mm interval, 35*940*23^{mm}) measuring tool with ±0.1cm precision was used for height measurements of the participants. Vestel V-fit smart scale (±0.1cm precision, Made in Turkey) was used for body weight and BMI measurements and the data were transferred to the application.

Balke Treadmill Test; In this protocol developed by Balke and Ware (1959) in which both speed and slope are increased, the treadmill test starts with a slope of 0% and a speed of 3,3$^{km/h}$. Within 15 minutes, the slope is increased by 2% after one minute and the slope is increased by 1% at one-minute intervals (Uslu et al., 2022). The practice was finished when the participants wanted to end the test.

Table 1. Balke treadmill tests norms

Statement	Balke Test Distance
Excellent	>2100
Above average	2000-2100
Average	1700-1999
Below Average	1600-1699
Poor	<1600

In this table, norm values between the ages of 13-15 are given.

Balke Treadmill Protocol MaxVO$_2$ Equality

In our study, it was used to estimate the maximum oxygen consumption capacity by using the formula ($MaxVO_2^{ml/kg/min}$ =1.38(time)+5.22).

Table 2. MaxVO$_2$ test norms

Statement	MaxVO$_2^{ml/kg/min}$
Very poor	<25
Poor	25-30.9
Average	31-34.9
Good	35-38.9
Excellent	39-41.9
Superior	>41.9

In this table, are given norm values between the ages of 13-15

Training protocol

In this study, in addition to the field training, the experimental group applied a 45-minute running protocol in an open and hilly area 2 days a week and the control group applied a 45-

minute aerobic running protocol in a flat area during the 8 weeks. 16 Fartlek exercise was performed on Tuesdays and Thursdays between 14:00-16:00.

Table 3. Fartlek group training protocol

Warm-up 5 minutes low level running
5 minutes of stretching movements
Sprinting in a way that does not strain the athletes 3/4- 1: 1/4-mile distance running (1400-1800m)
Fast Walking for 5 minutes with long steps
60-70 meters sprint
Walking with long steps
Maximal uphill running (150-170m)
2 min jogging at a low tempo
Pulse Down Exercises phase (1000m) Jogg
Finish

In this study, the devices (treadmill) to be used in detail and the measurement method were explained to the participants both visually and practically. The first measurement was performed with the participation of all subjects at the same time. After the measurement, the participants were asked to continue their normal field and running training. Then the exercise program, the last measurement was taken, and the study was completed.

Data analysis

SPSS 22 (Statistical Package for Social Sciences 22 Version) program was used for statistical analysis and calculations of our study. G*Power (3.1.9.4 version) program was used for sample size determination. The normality assumption of our research was tested by the Shapiro-Wilk method, and it was decided to use nonparametric tests. Because of didn't show normal dispersion was used to compare the pre-test and post-test averages and the Wilcoxon signed-rank test in the same sample group. Non-parametric Mann-Whitney U test was used to determine the difference between the two averages. The significance level of the study was set between ($p<0.00$-0.05). This study set up an effect size ($p=0.03$, $\alpha=0.05$; $\beta=0.85$) and found a sample size of enough ($N=18$) female basketball players.

Table 4. Normality coefficient ranges of variables

Variable	Test	Skewness	Kurtosis	Statistic
BW^{kg}	1	0.440±501	-2.206±982	0.971
	2	1.501±501	0.381±982	0.971
$BMI^{kg/m2}$	1	2.060±501	0.080±982	0.971
	2	2.801±501	-0.483±982	0.965
Balke $Test^{m}$	1	2.189±501	1.152±982	0.949
	2	1.182±501	2.811±982	0.959
$MaxVO_2^{ml/kg/min}$	1	2.219±501	1.152±982	0.949
	2	1.867±501	1.811±982	0.959

(BW = Body Weight, BMI= Body Mass Index, $MaxVO_2$ = Maximum oxygen consumption capacity)
Significance Level=(p<0,000-0,005)

The normality coefficient limit of our study was set between-1.5-1.5 (Alpar, 2018). It was decided that the findings did not show normal distribution and were used nonparametric tests.

FINDINGS

The research was conducted to determine the effect of the fartlek exercise on the aerobic capacity of adolescent female players. The information of findings is given in tables and the information is explained bellow figure.

Table 5. Descriptive information

Variable	Group	N	Min.	Max.	Mean+S.d
Age^{year}	Research Group	9	14	16	14.89±0.928
	Control	12	16	16	14.83±0.937
$Height^{cm}$	Research Group	9	157.30	178.60	165.41±6.000
	Control	12	157.40	178.10	168.47±5.930
BW^{kg}	Research Group	9	45.70	72.50	60.22±8.013
	Control	12	65.20	78.60	62.52±7.659

(BW= Body Weight)

In this table 5, it was found that the average age of the research group (N=12) was ($14.89±0.928^{years}$), the average height ($165.41±6^{cm}$), average BW ($60.22±8.013^{kg}$); the average age of the control group was (N=9) ($14.83±0.937^{years}$), average height ($168.47±5.930^{cm}$), average BW ($62.52±7.659^{kg}$).

Table 6. Body composition, balke test and $MaxVO_2$ measurements of participants (Intra-Group)

Variable	Test	Min.	Max.	Mean+S.d	z	p
BW^{kg}	Pre-test	48.70	72.50	60.22±8.01	-1.482	0.138
	Post-test	47.90	70.30	59.01±6.77		
$BMI^{kg/m2}$	Pre-test	17.65	25.78	22.01±2.70	-1.481	0.139
	Post-test	17.36	25.00	21.58±2.31		
Balke $Test^{m}$	Pre-test	1539	19.97	1818.77±161.39	-1.955	**0.041***
	Post-test	1520	20.29	1841.77±171.72		
$MaxVO_2^{ml/kg/min}$	Pre-test	23.12	33.36	29.37±3.60	-1.955	**0.041***
	Post-test	22.69	34.07	29.88±3.83		

(BW = Body Weight, BMI= Body Mass Index, $MaxVO_2$ = Maximum oxygen consumption capacity) Significance Level=(p<0,00-0,005*)

In Table 6, it was found that there was a decrease in the body composition averages of the participants in the research group (N=12). However, this differentiation was not significant

(p>0.005). It was found that there was a significant difference in the Balke Treadmill test and $MaxVO_2^{ml/kg/min}$ measurements accordingly.

Table 7. Body composition, Balke treadmill test and $MaxVO_2$ measurements of participants (Control Group)

Variable	Test	Min.	Max.	Mean+S.d	z	p
BW^{kg}	Pre-test	51.20	78.60	62.52±7.65	-2.703	**0.007***
	Post-test	50.00	76.80	61.44±7.19		
$BMI^{kg/m2}$	Pre-test	19.22	25.96	22.02±2.19	-1.962	**0.004***
	Post-test	19.15	25.37	21.65±2.15		
Balke $Test^{m}$	Pre-test	1619	1971	1782±119.44	-0.941	0.077
	Post-test	1638	1960	1791±113.73		
$MaxVO_2^{ml/kg/min}$	Pre-test	24.91	32.78	28.56±2.670	-0.941	0.077
	Post-test	25.33	32.53	28.76±2.542		

(BW= Body Weight, BMI= Body Mass Index, $MaxVO_2$ = Maximum oxygen consumption capacity) Significance Level=(p<0.00-0.005*)

Table 7 presents analyses; a decrease is observed in the body composition averages of the participants in the control group (N=9). It was found that this differentiation was significant (p<0.005). Although there was an increase in test scores it was found that this differentiation was not significant(p>0.005).

DISCUSSION AND CONCLUSION

There aren't more studies that test this parameter in adolescent girls' basketball players to investigate aerobic capacity. This study was conducted to determine the effect of Fartlek exercises on running performance and maximal oxygen consumption VO_2max values in female basketball players. Considering the findings obtained by reviewing the literature, it was discussed by the aim of the study.

Field tests applied in indoor and outdoor areas are used in the evaluation of athletes' VO_2 max the findings obtained from these tests can reach different results in the current branch and non-branch athletes (Vickers, 2003; Mitchell & Crandall, 2017). Maximal oxygen consumption VO_2max is accepted as an indicator of both health and endurance in athletes (Kodama et al., 2009; Barry et al., 2014; Aadland et al., 2017). Fartlek exercises are applied for the development of performance parameters of athletes. Pre-season and in-season training protocols are applied for development. In this study, it was found that there was a decrease in the body composition BW and BMI measurements of the experimental group in the findings in Table 2, but this difference was not significant. It was found that there was a significant difference in the averages of aerobic performance elements Balke test and VO_2max. In the control group measurements, it was found that there was both a decrease and a significant

difference in the table body composition BW, BMI measurements ($p<0.05$) and no significant difference in the Balke treadmill test and VO_2max measurements.

In the first test averages of the experimental and control groups were compared, and it was found that there was no difference in all variables BW, BMI, Balke Treadmill Test, VO_2max. When the post-test averages of the participants were compared, it was found that there was a difference in the Balke treadmill test and accordingly VO_2 max. It is seen that the treadmill test findings of the participants are weak, and VO_2 max averages are at average values according to age scale test norms. It is thought that VO_2 max development will continue with the continuation of endurance training protocols. According to the intra-group score, there is in aerobic capacity development and this data can be evaluated for the effect fartlek training protocol.

Fartlek exercises have a positive effect on the improvement of VO_2 max and resting pulse averages in athletes (Eleckuvan, 2014). Sarmidi and Rahmawati (2018) in their study titled 'Effect of Fartlek Training to the Improvement of VO_2max on Athletes Runners of 800-metres' found that the fartlek exercise protocol provides an improvement in athletes. Hazar and Hazar (2016), in their study titled 'The Effect of Continuous Running and Fartlek Training on Maximal Oxygen Consumption Capacity' found that there was a significant difference in favour of the last test. Permadi et al., (2020) found that the exercise protocol applied in the study titled 'Circuit Training to Increase Cardiorespiratory Endurance in Male Basketball Players' provided improvement in basketball players. Fahmi et al. (2014), found that there was no significant difference in their study titled 'Effect of Fartlek Training on Speed and Endurance Among Athletes'. In the study titled 'Effect of Fartlek Training on Speed and Endurance Among Athletes' by Jadav (2020), it was found that there was a significant difference in both speed and endurance measurements. Akyol and İmamoğlu (2020) in their study titled 'The Effects of a Three-Month Exercise on Physical Fitness, Body Composition and Some Blood Parameters in Sedentary Middle-Aged Female' VO_2max measurements were found to have a significant difference in favour of the last test ($p<0.05$). Sarifin et al. (2020) 'Comparison of Interval Training and Fartlek Training Against VO_2max Athlete FIK UNM Basketball' found that fartlek exercises improved This study is thought to contribute to the literature in terms of quantity. measurements. Nambi et al. (2020), conducted a 'Comparative effectiveness study of low versus high-intensity aerobic training with resistance training in community-dwelling older men with post-COVID-19 sarcopenia: A randomised controlled trial' and found no significant difference in VO_2max measurements. Stojmenović et al. (2020) in their 'Comparative study of aerobic

capacity among elite basketball players according to five different positions in the team' found that there was an improvement in VO_2max values, but this improvement was not found to be significant.

As a result, it is seen that there are studies with similar and different results in the literature. It is thought that the different results of these studies may be due to the differences in the training protocol and sample group. It was concluded that the 8-week fartlek endurance training program caused significant increases in running distance and VO_2max measurements and had a positive effect on endurance performance parameters in non-elite female basketball players with an average age of (14.89 ± 0.928^{years}). It is seen that the Balke treadmill test findings should be improved VO_2max, and the mean values are at average values in the test scale. In addition, it is thought that a decrease in BW and BMI values will have a positive effect on the performance parameters of athletes.

It is thought that this aerobic training protocol may be appropriate in terms of performance development and continuity in the seasonal phases of athletes.

GENİŞLETİLMİŞ ÖZET

GİRİŞ

Basketbol ulusal ve uluslararası düzenlenen organizasyonlarda hem kadın hem de erkek sporcuların yarıştığı oyun içerisinde sporcuların temel motorik özelliklerini sergilendiği teknik becerinin yanında maç kazanmada fiziksel parametrelerinde etkili olduğu bir spor branşıdır (Sutanto, 2016; Vasconcelos ve ark., 2017). Bu nedenle basketbolcuların hazırlık ve müsabaka döneminde fiziksel, bilişsel, teknik ve taktik antrenman programlarının yapılması gelişimleri izlenmesi önemli olduğu uzmanlar tarafından belirtilmektedir (Ziv & Lidor, 2009). Antrenörler ve atletik performans uzmanları; sporcularda performans gelişimi amacıyla çeşitli antrenman protokolleri uygulamaktadır (Puente ve ark., 2017). Bu antrenman metotlarından biri de sporcuların dayanıklılık özelliklerini geliştiren fartlek koşu egzersizleridir. Fartlek egzersizlerin sporcuların kuvvet gelişimi ve aerobik kapasitesinin artışında etkili olmakla birlikte çok sayıda farklı antrenman metotları bulunmaktadır (Jones, 2016). Fartlek antrenmanları, açık ve engebeli olan alanlarda uygulanmakta koşu esnasında tempo hızlı ve yavaş olarak devam etmektedir. Sporcuların seviyesine göre kurgulanan fartlek egzersizler, katılımcıların aerobik kapasitesini de tespit etmektedir. Fartlek egzersizler aerobik eşik seviyesinde ilerleme sağlamakta ve bunun sonucunda performans artışı gözle görülür seviyede ilerlemektedir (Bompa, 1999).

Maksimal oksijen tüketim kapasitesi VO_2max sporcuların aerobik kapasitesinin göstergesidir. Başka bir ifadede kalbin çalışan kaslara oksijen taşıma özelliğine göre en yüksek düzeyde oksidatif Adenozin Trifosfat (ATP) üretiminin sürdürülebilmesi için, kullanılan oksijen miktarı olarak tanımlanır

(Levine, 2008). VO_2max, egzersiz şiddetinde artış olmasına rağmen alınan oksijende değişim gözlenmemektedir (George ve ark., 2009).

Adölesan kız basketbolcularda fartlek antrenmanların aerobik performans parametrelerinde gelişimini tespit etmeye yönelik çalışma nicelik bakımından sınırlıdır. Yapılan bu çalışma yaş, branş ve cinsiyet faktörleri göz önüne alınarak literatüre katkı sağlayacağı düşünülmektedir. Çalışmamız, en az 4 yıl basketbol geçmişi olan müsabık adölesan kız basketbolcularda 8 hafta boyunca uygulanan fartlek egzersizlerin, aerobik koşu performansı ve VO_2max seviyesini etkisini tespit etmek amacıyla yapılmıştır.

YÖNTEM

Araştırma grubu

Çalışmamızın örneklem grupları düzenli antrenman yapan müsabık çalışma grubu (n=12, yaş:14,89±0,928^{yıl}, boy:168,41±6,000^{cm}, VA:61,44±8,013^{kg}) kontrol grubu (n:9, yaş:14,83±0,937^{yıl}, boy:165,47±0,590^{cm}, VA:60,22±7,659^{kg}) basketbolculardan oluşmaktadır. Araştırma öncesi katılımcılar ve velileri ile toplantı gerçekleştirilmiş çalışmamızın içeriği hakkında bilgilendirme yapılmıştır. Gönüllük esasına göre gerçekleştirilen bu çalışmada detaylı onam formu velilere imzalatılmıştır.

BULGULAR

Ölçümler sonucunda çalışma grubunda koşu mesafesinde (metre) ve VO_2max artış, kontrol grubunda ise VA, BKI anlamlı farklılaşma olduğu bulgusuna ulaşılmıştır. Grup ortalamalarının karşılaştırıldığında; koşu mesafesi ve maksimal oksijen tüketim kapasitesinde VO_2max 2. ölçümlerinde anlamlı farklılaşma olduğu bulgusuna ulaşılmıştır.

TARTIŞMA VE SONUÇ

Çalışmamız Fartlek egzersizlerin kız basketbolcularda koşu performansı ve VO_2max değerlerine etkisini tespit etmek amacıyla yapılmıştır. Literatür taranarak elde edilen bulgular ışığında çalışmanın amacına uygun olarak tartışılmıştır.

Literatürde benzer ve farklı sonuçlara ulaşılan çalışmalar olduğu görülmektedir. Bu çalışmaların farklı sonuçlara ulaşılmasında antrenman protokolü ve örneklem grubunun farklılığından kaynaklanabileceği düşünülmektedir. 8 haftalık kurguladığımız fartlek dayanıklılık antrenman programının yaş ortalaması (14,89±0,928) olan elit olmayan kız basketbolcularda koşu mesafesi ve VO_2max ölçümlerinde anlamlı ($p<0,05$) artışlara sebep olduğu ve dayanıklılık performans parametrelerine olumlu etki yaptığı sonucuna ulaşılmıştır. Balke koşu bandı testi bulgularının geliştirilmesi gerektiği VO_2max ortalamalarında ise test skalasında ortalama değerlerde olduğu görülmektedir. Ayrıca VA ve BKI değerlerinde azalma olmasının sporcuların performans parametrelerine pozitif etki yapacağı düşünülmektedir.

REFERENCES

Aadland, E., Solbraa, A. K., Resaland, G. K., Steene-Johannessen, J., Edvardsen, E., Hansen, B. H., … et al. (2017). Reference values for and cross-validation of time to exhaustion on a modified Balke protocol in Norwegian men and women. *Scandinavian Journal of Medicine & Science in Sports*, 27(11), 1248-1257. https://doi.org/10.1111/sms.12750

Akyol, P., & İmamoğlu, O. (2019). The effects of a three-month exercise on physical fitness, body composition and some blood parameters in sedentary middle-aged female. *Journal of Education and Training Studies, 7*(11), 63-71. https://doi.org/10.11114/jets.v7i11.4424

Bompa, T., O. (1999)., *Periodisation theory and methodology*. IL Human kinetics.

Eleckuvan, M., R. (2014). Effectiveness of fartlek training on maximum oxygen consumption and resting pulse rate. *International Journal of Physical Education, Fitness and Sports*, *3*(1),85-88. https://doi.org/10.26524/14115

George, J. D., Paul, S. L., Hyde, A., Bradshaw, D. I., Vehrs, P. R., Hager, R. L., … et al. (2009). Prediction of maximum oxygen uptake using both exercise and non-exercise data. *Measurement in Physical Education and Exercise Science*, *13*(1), 1-12. https://doi.org/10.1080/10913670802609086

Hazar, K., & Hazar, S. (2016). The effect of continuous running and fartlek training on maximal oxygen consumption capacity. *Nigde University Journal of Physical Education and Sport Sciences, 3*(10), 351-356

Fahmi, B. S., Omar, A. H., & D. Hamid. (2014). The effects of fartlek training in improving cardiorespiratory fitness among elderly. *Malaysian Journal of Movement, Health and Exercise. 8*(7),58-63

Feasel, C. D., Sandroff, B. M., & Motl, R. W. (2021). Cardiopulmonary exercise testing using the modified Balke protocol in fully ambulatory people with multiple sclerosis. *Cardiopulmonary Physical Therapy Journal*, *32*(2), 57-65. https://doi.org/10.1097/CPT.0000000000000141

Uslu, S., Hindistan, I. E., & Çetin, E. (2022). Determination of maximum oxygen consumption by machine learning methods using step kinematics. *Journal of Sport and Performance Research*, *13*(2), 201-216. https://doi.org/10.17155/omuspd.1097679

Levine, B., D. (2008). VO_2max: what do we know, and what do we still need to know? *The Journal of Physiology*. *586*(1), 25-34. https://doi.org/10.1113/jphysiol.2007.147629

Mitchell, R. D., & Crandall, C. (2017). Validation of the 15-minute Balke field test for competitive, adult 5k runners: From treadmill VO_2max testing to enhancing performance. *American Journal of Sports Science and Medicine*, *5*(3), 44-47. https://doi.org/10.12691/ajssm-5-3-1

Nambi, G., Abdelbasset, W. K., Agrawal, S. M., Elsayed, S. H., Verma, A., Vellaiyan, A., … et al. (2022). Comparative effectiveness study of low versus high-intensity aerobic training with resistance training in community-dwelling older men with post-COVID-19 sarcopenia: A randomised controlled trial. *Clinical Rehabilitation*, *36*(1), 59-68. https://doi.org/10.1177/02692155211036956

Sarmidi, S. (2018). *Effect of fartlek training on the improvement of VO_2max on athlete's runners of 800-metres. in an international seminar on public health and education*, Atlantis Press.

Sutanto, Teguh. (2016). *Buku pintar olahraga*. Pustaka Baru Press

Stojmenović, D., Trunić, N., & Stojmenović, T. (2022). A comparative study of aerobic capacity among elite basketball players according to five different positions in the team. *Journal of Physical Education and Sport*, *22*(10), 2522-2529. https://doi.org/10.7752/jpes.2022.10320

Fauzan, M. A., Sarifin, S., & Setyagraha, E. (2020). *Perbandingan latihan interval dan latihan fartlek terhadap VO_2max atlet bola basket fik unm* (Doctoral dissertation, Unıversıtas Negerı Makassar). http://eprints.unm.ac.id/19754/

Jadhav, R. (2020). Effect of fartlek training on speed and endurance among athletes. *International Journal of Multidisciplinary Educational Research*, *9*(12), 123-129.

Jones A., M. (2016). *Sport and exercise physiology testing guidelines.* Routledge.

Vasconcelos, T., Hall, A., & Viana, R. (2017). The influence of inspiratory muscle training on lung function in female basketball players- a randomised controlled trial. *Porto Biomedical Journal*, *3*(2), 86-89 https://doi.org/10.1016/j.pbj.2016.12.003

Vickers, R., R. (2003). *Measurement error in maximal oxygen uptake tests*. Naval Health Research Centre.

Ziv G., & Lidor R. (2009). Physical attributes, physiological characteristics, on-court performances, and nutritional strategies of female and male basketball players. *Sports Medicine, 7*(39), 547-68. https://doi.org/ 10.2165/00007256-200939070-00003

Puente, C., Abián-Vicén, J., Salinero, J. J., Lara, B., Areces, F., & Del Coso, J. (2017). Caffeine improves basketball performance in experienced basketball players. *Nutrients, 9*(9), 1033. https://doi.org/10.3390/nu9091033

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Tasarım *Design*	Yöntem ve araştırma desenini tasarlamak *To design the method and research design.*	Murat Bekleyiş APAYDIN Samet SİTTİ
Literatür Tarama *Literature Review*	Çalışma için gerekli literatürü taramak *Review the literature required for the study*	Murat Bekleyiş APAYDIN Samet SİTTİ
Veri Toplama ve İşleme *Data Collecting and Processing*	Verileri toplamak, düzenlemek ve raporlaştırmak *Collecting, organizing and reporting data*	Murat Bekleyiş APAYDIN Samet SİTTİ
Tartışma ve Yorum *Discussion and Commentary*	Elde edilen bulguların değerlendirilmesi *Evaluation of the obtained finding*	Murat Bekleyiş APAYDIN Samet SİTTİ

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