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Comparison of Elite Orienteering Athletes 'Physical and Mental Test Parameters with Their End-of-Season Competition Results

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Abstract

Orienteering is a nature sport that requires intense physical and mental performance, in which athletes attempt to find designated control points in challenging terrain using a map and compass. The present study aims to compare the physical and mental parameters measured using various tests in orienteering athletes with their end-of-season competition results and to determine the parameters that affect performance. Twenty-one male athletes competing in the elite category of the Turkish Orienteering Federation league participated in the study. Participants were divided into two groups based on their experience in the sport: inexperienced (2-5 years) and experienced (5 years and above). To measure physical performance parameters, the participants underwent a sit-and-reach flexibility test, a 20 m sprint test, Illinois agility test, active jump test, squat jump test, McGill core endurance test, isokinetic muscle strength measurement, running-based anaerobic sprint test (RAST), and 3000 m run test. To measure mental performance parameters, the D2 attention test, spatial visualization test, and mental rotation test were administered. The analysis revealed a statistically significant negative correlation between active jump, squat jump, RAST fatigue index, and 3000 m run test results and end-of-season competition scores, and a statistically significant positive correlation between years of experience and end-of-season competition scores. Regression analysis revealed that experience and aerobic endurance are two important components that influence performance. The findings show that the two most decisive variables affecting end-of-season performance are aerobic endurance (3000 m test) and athlete experience. This reveals that, in addition to physical capacity, sport-specific experience is also a critical factor in performance.

Keywords: Orienteering, Aerobic endurance, 3000m running, Experience.

Elit oryantiring sporcularının fiziksel ve zihinsel test parametrelerinin sezon sonu yarışma sonuçları ile karşılaştırılması

Özet

Oryantiring; sporcuların zorlu arazilerde belirlenen kontrol noktalarını harita ve pusula yardımıyla bulmaya çalıştığı yoğun fiziksel ve zihinsel performans gerektiren bir doğa sporudur. Bu çalışmada oryantiring sporcularında çeşitli testler kullanılarak ölçülen fiziksel ve zihinsel parametrelerin sezon sonu yarışma sonuçları ile karşılaştırılması ve performansa etki eden parametrelerin belirlenmesi amaçlanmıştır. *Yöntem:* Çalışmaya Türkiye Oryantiring Federasyonu ligi elit kategoride yarışan 21 erkek sporcu katılmıştır. Katılımcılar; spor branşındaki deneyim durumlarına göre az deneyimli (2-5 yıl) ve deneyimli (5 yıl ve üzeri) olmak üzere iki gruba ayrılmıştır. Katılımcılara fiziksel performans parametrelerini ölçmek amacıyla; otur-eriş esneklik testi, 20 m sprint testi, illinois çeviklik testi, aktif sıçrama testi, squat sıçrama testi, McGill core dayanıklılık testi, izokinetik kas kuvveti ölçümü, koşu tabanlı anaerobik sprint testi (RAST) ve 3000 m koşu testi, zihinsel performans parametrelerini ölçmek amacıyla; d2 dikkat testi, uzamsal görselleştirme testi ve zihinsel döndürme testi uygulanmıştır. *Bulgular: Y*apılan analiz sonucunda aktif sıçrama, squat sıçrama, RAST yorgunluk indeksi ve 3000m koşu testi sonuçları ile sezon sonu yarışma puanları arasında istatistiksel olarak negatif yönlü, deneyim yılı değişkeni ile sezon sonu yarışma puanları arasından istatistiksel olarak pozitif yönlü anlamlı ilişki bulunmuştur. Regresyon analizi sonucunda deneyim ve aerobik dayanıklılığın performansa etki eden iki önemli bileşen olduğu sonucuna varılmıştır. *Sonuç:* Bulgular, sezon sonu performans üzerinde en belirleyici iki değişkenin aerobik dayanıklılık (3000 m testi) ve sporcu deneyimi olduğunu göstermiştir. Bu durum, fiziksel kapasitenin yanı sıra spora özgü birikimin de performans açısından kritik bir unsur olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Oryantiring, Aerobik dayanıklılık, 3000m koşu, Deneyim.

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INTRODUCTION

Orienteering is a nature sport that requires both physical and mental skills, usually carried out in wooded areas, based on finding control points placed in a pre-mapped area in a specific order and in the shortest time possible, using specially drawn maps and a compass (Lowry and Sydney, 1985, McNeill et al., 1998). This discipline, in which athletes simultaneously use skills such as speed, endurance, navigation, and decision-making, is considered one of the most challenging sports at the international level, as individuals compete against both themselves and variable terrain conditions (Lowry and Sydney, 1985).

Analyses conducted in different types of competitions have observed that athletes' heart rates range between 140 and 180, demonstrating that orienteering is largely an aerobic sport (Bird et al., 1993). Studies conducted on world-class athletes have shown that athletes achieve the best results in middle- and long-distance races in the forest by maintaining their speed as constant as possible, slightly below their anaerobic threshold level (Gasser, 2018). In this context, successful orienteering performance depends on high physical fitness, high aerobic capacity, and physical endurance through alternating movements such as jumping and sprinting, which require anaerobic effort (Batista et al., 2020). However, cognitive capacity and experience are also among the key factors determining success in competitions. Athletes must read the map while running to determine the most suitable route, which requires a high level of attention and decision-making skills (Lowry and Sydney, 1985, Creagh and Reilly, 1997).

Physical fitness plays a decisive role in an athlete's performance under difficult terrain conditions. Inadequate physical fitness leads to rapid fatigue, which in turn impairs map reading skills (Lowry and Sydney, 1985). In this context, considering situations such as rapid changes in direction, overcoming obstacles, and coping with uneven terrain, the ability to use elastic energy efficiently, sufficient muscle strength, and endurance play a critical role in the athlete's performance. It is emphasized that lower limb muscle strength must be more developed than that of other long-distance runners in such conditions (Batista et al., 2020). In a previous study, a moderate to high correlation was found between leg muscle strength and VO2max and anaerobic power, and it was indicated that muscle strength is a key variable in improving orienteering performance (Çinar-Medeni et al., 2016).

Due to the nature of orienteering, athletes need a high level of flexibility and agility when running through wooded and rugged terrain. Situations such as jumping over fallen trees, crawling under them, or descending steep cliffs highlight the importance of flexibility and body control. These characteristics contribute to energy conservation by ensuring the continuity of the running flow (McNeill, 2010). Although orienteering is generally classified as an aerobic

endurance sport, this continuity is occasionally interrupted due to high-intensity anaerobic sections such as sprints and hill climbs (Batista et al., 2020). When considering tasks such as sprint races, mass starts, and reaching the finish line, the ability to run fast on different terrains becomes a decisive factor in an athlete's performance. Therefore, the analysis of short-distance sprints should be seen as an important tool in evaluating the high-level performance of orienteering athletes (Hebert-Losier et al., 2014).

Orienteering competitions are usually held in forested or open rural areas, where athletes often have to run on off-road terrain. In this context, the ability to maintain balance and avoid obstacles with agile movements while running on rough terrain is of great importance. Given the variable terrain structure of orienteering, agility and balance skills are fundamental elements for successful performance (Bird et al., 2001).

However, it is clear that orienteering is not limited to physical fitness alone, but that mental skills also play a decisive role in success. The mental qualities required to succeed in this sport include advanced navigation skills such as map reading, compass use, and distance estimation, as well as high concentration, motivation, self-confidence, the ability to flexibly adjust focus, strategic thinking, flexibility in problem solving, emotional control, and high pain tolerance (Lowry and Sydney, 1987).

Although orienteering is a complex sport involving both physical and cognitive components, the literature generally addresses these components separately, with studies focusing either on physical capacity (endurance, muscle strength, agility, etc.) or mental abilities (map reading, navigation, decision-making, etc.). However, performance in orienteering is shaped by the simultaneous and coordinated use of these two skill groups. Therefore, the number of studies that comprehensively examine both physical and mental demands is quite limited. This study aims to fill this gap in the literature by evaluating the physical and cognitive elements inherent in orienteering together and to address the athlete's performance with a multidimensional approach.

MATERIAL AND METHOD

Participants Twenty-one athletes competing in the Elite Men's category of the 2020-2021 season of the Turkish Orienteering Federation Orienteering League volunteered to participate in the study. Ethical approval was obtained from the Scientific Research and Publication Ethics Committee of the Faculty of Science and Engineering at Eskişehir Technical University in order to conduct the study.

Study Design. The athletes participating in the study were divided into two groups based on their years of experience: less experienced (2-5 years) and experienced (5 years and above). All participants underwent tests to determine their physical performance parameters, including the sit-and-reach flexibility test, 20 m sprint test, Illinois agility test, active jump test, squat jump test, McGill core endurance test, isokinetic muscle strength measurement, running-based anaerobic sprint test (RAST), and 3000 m running test. To determine mental performance parameters, the D2 attention test, spatial visualization test, and mental rotation test were administered.

Physical Tests Performed

Sit-and-reach flexibility test: Participants' flexibility was measured using the Sit and Reach test, which was administered three times to each participant, with the highest value being taken into account.

Isokinetic muscle strength measurement: Participants' isokinetic muscle strength values were measured at the knee joint during extension and flexion movements at angular velocities of 60°/s, 180°/s, and 300°/s. Three trial repetitions were performed for each extremity, and the highest value was taken as the peak torque value.

McGill core endurance test: Core muscle endurance was measured using the McGill Core Endurance Test protocol. This protocol includes tests of trunk flexor, lateral, and extensor endurance.

Jump tests: Participants underwent the Squat Jump Test (SST) and Active Jump Test (AST), which were performed using the My Jump 2 mobile app. Athletes completed a total of 3 repetitions, and the highest value was considered.

20 m sprint test: A 20-meter sprint test was administered to determine participants' speed performance, and the best score from the three tests was evaluated.

Agility test: The Illinois agility test was administered to measure agility skills. Prior to the test, participants were introduced to the course and asked to perform 2-3 trials at a low pace. The Illinois agility test was administered three times, and the best score was evaluated.

Running-based anaerobic sprint test (RAST): The starting and finishing points of the running track were marked with two cones, with a distance of 35 meters between them. Photocells were

placed at the starting and finishing points of the course. The RAST consists of six consecutive 35-meter sprints with a 10-second recovery period between each sprint.

3000m running test: In accordance with the selection criteria of the Turkish Orienteering Federation National Team, a 3000m running test was conducted on a 400m athletics track to assess participants' aerobic endurance, with participants required to complete the course in the shortest possible time. This test was administered to each athlete only once.

Mental Tests Performed

d2 attention test: The d2 attention test was used to evaluate participants' attention performance. Participants were asked to mark "d" letters with specific points. The test was administered once to each participant.

Mental rotation test (MRT): The Mental Rotation Test developed by Peters and colleagues and adapted into Turkish by Yıldız was used in this study (Peters et al., 1995, Yildiz, 2009).This test measures individuals' ability to mentally visualize and recognize new shapes formed when shapes are rotated in different directions and angles in space.

Spatial visualization test (SVT): In this study, the Spatial Visualization Test (SVT) developed by Lappan as part of the "Middle Grades Mathematics Project" and adapted into Turkish by Dursun was used to assess athletes' spatial skills (Lappan, 1981, Dursun, 2010). The test aims to measure individuals' ability to mentally visualize, rotate, and analyze three-dimensional objects. The SVT consists of a total of 10 different question types, including recognizing the views of three-dimensional shapes from different angles, determining the number of cubes in structures made up of unit cubes, identifying the overlapping surfaces of specified cubes, defining the bird's-eye views of shapes, and analyzing structure plans through cube addition and subtraction operations.

End-of-Season Competition Scores: Participants' season-end competition scores were taken from the individual rankings published by the Turkish Orienteering Federation at the end of the season. The end-of-season competition scores are obtained by subtracting the scores from the two worst races from the total score obtained from the seven races run in the 2020-2021 orienteering league, in accordance with the national team selection criteria.

Statistical Analysis Statistical analyses of the data were performed using the SPSS Statistics 25 program. Due to the small sample size (less than 50 participants), the Shapiro-Wilk test was used to test the assumption of normality. Athletes were divided into two groups based on their orienteering experience: those with 2–5 years of experience were classified as "less experienced," while those with 5 years or more of experience were classified as "experienced." For intergroup comparisons, the Independent Samples t-test was applied for data showing a normal distribution, and the Mann-Whitney U test was applied for data not showing a normal

distribution. Correlation analyses were performed to determine the relationships between the data obtained from physical and mental tests and the end-of-season competition scores. In this context, Pearson correlation was used for variables showing a normal distribution, and Spearman correlation test was used for variables not showing a normal distribution. Finally, stepwise multiple regression analysis was applied to determine the effect of variables found to be significantly related to end-of-season competition scores on these scores.

FINDINGS

The study included participants competing in the Elite Men category (E-21E), aged 18 years or older, with at least 2 years of orienteering experience, aged 29.00±5.70 years, height 177. 16±4.66 cm, weighing 69.17±8.43 kg, with a body fat percentage of 10.56±3.76, and 11.83±4.15 years of experience.

Table 1. Comparison results of flexibility, 20 m sprint, agility, active jump, squat jump, and 3000 m run test according to the experience groups of orienteering athletes

VARIABLES	Less experienced (n=9) (2-5 years)		Independent Samples t test		Experienced (n=12) (5 years and above)	
	Mean	SD	t =	p =	Mean	SD
Flexibility	30.27	7.36	-.953	.352	33.08	6.12
20 m sprint	3.32	0.36	2.462	.030*	2.98	0.22
Agility	16.26	.51	-.632	.535	16.38	.34
Active jump	37.98	4.15	2.274	.035*	32.92	5.60
Squat jump	35.96	5.77	2.780	.012**	30.03	4.01
3000 m running test	638.44	59.12	0.764	.453	621.58	42.17

There was no significant difference between the data from the flexibility test (t = -0.953, p = 0.352), agility test (t = -0.632, p = 0.535), and 3000m run test (t = 0.764, p = 0.453) performed based on the experience groups of the participants. However, statistically significant differences were observed between the experience groups in the 20 m sprint test (t = 2.462, p = 0.030*), active jump test (t = 2.274, p = 0.035*) and squat jump test (t = 2.780, p = 0.012**).

When comparing the tests according to experience groups, no statistically significant differences were observed between groups in RAST parameters, isokinetic leg muscle strength test, and spatial

visualization and mental rotation test data (p > 0.05). However, a significant difference was found between the experience groups for the McGill core endurance test data for the right lateral trunk strength test (z = -3.094, p = 0.002**). When comparing spatial visualization and mental rotation test data according to experience groups, no statistically significant difference (p<0.05) was found between the groups.

When comparing d2 attention test parameters according to participants' experience groups; there was a significant difference between TM scores (t=-2.554, p=.026*), H2 scores (t=2.323, p=.031*), TM-H scores (t=-3.259, p=.004**) and KP scores (t=-3.104, p=.006**).

Table 2. Comparison of end-of-season competition scores for orienteering athletes according to experience groups

VARIABLES	**Less Experienced (n=9) (2-5 years)**		**Independent Samples t test**		**Experienced (n=12) (5 years and above)**	
	Mean	**SD**	**t =**	**p =**	**Mean**	**SD**
End-of-season competition points	3678.66	414.28	-3.300	.004**	4313.83	451.87

When comparing season-end competition scores by experience group, a statistically significant difference was found between groups (t=-3.300, p=.004**).

Table 3. Table of variables related to end-of-season competition points

		r	**p**
End-of-season competition points	**Active jump**	-.462*	.035
	Squat jump	-.479*	.028
	RAST fatigue index	-.448*	.042
	3000 m running test	-.543****	.011
	Experience	.638**	.002

When examining the relationship between orienteering athletes' experience and physical-mental test parameters and their end-of-season competition scores, experience (r=.638**, p=.002) was found to have a statistically positive correlation with end-of-season competition scores, while among the physical test parameters of orienteering athletes, active jump test data (r=-. 462*, p=.035), squat jump test data (r=-.479*, p=.028), RAST fatigue index data (r=-.448*, p=.042), and 3000 m run test data (r=-0.543*, p=. 011) were found to have a statistically significant negative relationship with end-of-season competition scores.

In the present study, stepwise multiple linear regression analysis was used to determine the mental and physical parameters (independent variables) that affect the end-of-season competition scores defined as

the dependent variable. As a result of the correlation analysis, the independent variables active jump, squat jump, RAST fatigue index, 3000 m run, and experience, which were related to the dependent variable, were included in the analysis, and a multiple regression model was applied. In the first stage of the model, it was determined that the number of years of experience had a significant effect on end-of-season competition scores ($F=13.080$, $R^2=.408$). At this stage, it was observed that the experience independent variable explained approximately 40.8% of the variance in the end-of-season competition score.

In the second stage of the model, the 3000 m independent variable was included in the model. The experience and 3000 m running variables together showed a significant relationship with the end-of-season competition scores. It was observed that the two variables together explained approximately 56.7% of the variance in the end-of-season competition score, and according to the standardized regression coefficient, the relative order of importance of the predictor variables on the end-of-season competition scores was determined as experience year and 3000 m run.

Table 4. The effect of orienteering experience and 3000 m running performance on end-of-season competition scores

	B	**SE**	**Beta**	**t**	**p**	**F**	**Model(p)**	**R^2**
Stage 1								
(Constant)	3475.778	181.462		19.154	.000	13.080	.002	.408
Experience	67.134	18.562	.639	3.617	.002			
Stage 2								
(Constant)	6316.162	1113.547		5.672	.000	11.803	.001	.567
Experience	58.385	16.649	.555	3.507	.003			
3000 m running	-4.400	1.707	-.408	-2.577	.019			
Dependent Variable: End-of-Season Competition Points								

DISCUSSION AND CONCLUSION

Evaluation of Physical Test Parameters Based on the Experiences of Orienteering Athletes

In a study conducted by Çolakoğlu et al., physical tests administered to elite orienteering athletes revealed that the average 20-meter sprint test result was 3.53±0.32 seconds, while the flexibility test result was 24.44±7.89 cm. In this study, similar tests were administered to experienced and less experienced athletes; the 20-meter sprint test was measured at 3.32±0.36 seconds for less experienced athletes and 2.98±0.22 seconds for experienced athletes. A significant difference in favor of experienced athletes was found in the sprint test. Flexibility test results were 30.27±7.36 cm for less experienced athletes and 33.08±6.12 cm for experienced athletes, but no statistically significant difference was found despite the better performance of experienced athletes (Çolakoğlu et al., 2014).

In the study by Örsçelik et al., the 20 m sprint values were determined to be 3.8±0.5 s in successful athletes and 3.6±0.6 s in unsuccessful athletes (Öreçelik et al., 2017). These results are slower than the sprint times obtained in the present study, suggesting that the athletes participating in the present study are at a more advanced physical level. Isokinetic muscle strength parameters were also evaluated in the same study, and the values for these parameters were found to be higher in this study (e.g., right leg extensor strength was 203.33±22.26 Nm in less experienced athletes and 205.16±36.08 Nm in experienced athletes). This difference may be attributed to the fact that the participants in the present study were elite-level athletes.

Interestingly, in the active and squat jump tests, the less experienced group had higher values, and these differences were found to be statistically significant. Although this finding may seem unexpected at first glance, similar results were obtained in a study conducted by Losier and colleagues with orienteering athletes. (Hebert-Losier et al., 2014). This situation can be explained by the fact that experienced athletes' muscle adaptations have developed more in the direction of endurance rather than jumping. It is likely that orienteering athletes have shifted their focus from explosive strength to muscle endurance as a result of frequent competitions and training sessions.

Since orienteering is performed in natural environments and challenging terrain conditions, strong core muscles and body stability are crucial for performance. In this context, McGill Core tests were administered, and a statistically significant difference in favor of experienced athletes was found, particularly in the right lateral strength parameter. Although experienced athletes achieved better results in other core strength parameters, these differences were not found to be significant. Similarly, Krutsch and colleagues noted higher core muscle strength

and flexibility in professional football players, supporting the association between athlete level and core strength (Krutsch et al., 2015).

As a result, there are significant differences in sprint, isokinetic strength, and core muscle strength among orienteering athletes depending on their level of experience. While differences in favor of experienced athletes were observed in sprint and core tests, it is noteworthy that less experienced athletes performed better in jump tests. These findings indicate that training programs for orienteering athletes should be designed to support not only endurance-based training but also explosive strength and core strength development.

Evaluation of Mental Test Parameters Based on the Experiences of Orienteering Athletes

In this study, the d2 attention test, spatial visualization test (UGT), and mental rotation test (ZDT) were administered to evaluate the mental performance of orienteering athletes according to their experience levels. According to the d2 attention test results, there were significant differences in favor of experienced athletes in terms of total marked item count (TM), inattentive errors (H2), total item-error difference (TM-H), and quality performance (KP) scores. The higher TM scores of experienced athletes indicate that they are superior in terms of attention continuity, motivation, and psychomotor speed. The higher H1 and H2 error counts in less experienced athletes indicate selective attention deficits, difficulty following instructions, and lower performance quality. The higher TM-H and KP scores in experienced athletes reveal that this group has more developed attention levels as well as psychomotor speed and stability.

Atakurt similarly noted that experienced athletes had significant advantages in H1 and H% values (Atakurt, 2018). Although these differences are not statistically significant in the present study, the trend in favor of experienced participants continues. In another study conducted by Atakurt, Şahan, and Erman, an 8-week orienteering training program was found to significantly improve children's attention levels, supporting the positive effect of orienteering on attention development (Atakurt et al., 2017).

No statistically significant differences were found between the groups based on the results of the spatial visualization test (SVT) and mental rotation test (MRT). Despite these results, Şengör's study showed significant improvement in spatial visualization skills after eight weeks of orientation training (Şengör, 2018). Çelgin (2021) compared athletes from different disciplines and found that orienteering athletes demonstrated a statistically significant advantage in spatial skills. Schmidt et al. stated that individuals who engage in sports perform better in mental rotation tasks than those who do not, and that orienteering athletes and gymnasts perform better than others. However, no significant difference was found between

these two sports (Schmidt et al., 2016). In the study conducted by Weigelt and Memmert with basketball players, it was noted that experienced athletes demonstrated better mental rotation performance; however, due to the sport-specific nature of the test, its generalizability was found to be limited (Weigelt and Memmert, 2020).

These findings indicate that orienteering athletes show experience-dependent development in terms of attention level and psychomotor speed, but that the effect of experience on spatial and mental rotation skills may be more limited or may not be apparent due to the nature of the tests.

Comparison of Physical and Mental Test Parameters of Orienteering Athletes with End-of-Season Competition Scores

The literature describes orienteering as an endurance sport that is physically and mentally demanding, sometimes requiring anaerobic performance but mostly relying on high aerobic capacity (Lowry and Sydney, 1985; Creagh and Reilly, 1997; Batista et al., 2020). Terrain conditions and the necessity of navigation distinguish this discipline from classical running sports, with physical fitness, cognitive capacity, and experience all playing important roles in success. In this context, a correlation analysis was conducted in the present study to investigate the relationship between end-of-season competition scores and physical and mental test parameters. Statistically significant and negative correlations were found between physical parameters such as active jump, squat jump, RAST fatigue index, and 3000 m running test data and end-of-season scores. In contrast, a positive and significant correlation was found between athletes' years of experience and end-of-season competition scores.

In terms of mental skills, the literature reports that attention, concentration, and spatial abilities are effective in orienteering (Lowry and Sydney, 1987). No significant relationship was found between the mental tests used in this study (attention level, spatial visualization, mental rotation) and end-of-season scores. This situation may be due to the tests not being specific to the sport, suggesting that more specific tests need to be developed to measure mental parameters.

Physical test results are also supported by the literature. For example, Degens and colleagues showed in their study with athletes from different sports, including orienteering, that endurance athletes produce less anaerobic power compared to strength/power athletes (Degens et al., 2019). Loturco and colleagues, on the other hand, noted that strength athletes performed better in squat jump, active jump, and drop jump tests (Loturco et al., 2015). These differences are explained by muscle fiber composition and training adaptations.

Additionally, age is known to affect muscle composition. Lexell's study indicates that fast-twitch muscle fibers decrease more than slow-twitch fibers with age (Lexel and Downham,

1991). In this context, the negative relationship observed in the present study between active jump and squat jump test results and end-of-season scores can be explained by age and the reduction of explosive power due to long-term aerobic training.

The fatigue index of the RAST test provides information about the athlete's anaerobic capacity (Nick and Whyte, 1997). In this study, while the average power data of experienced athletes were found to be higher, the maximum power data of less experienced athletes were found to be higher, but a performance decline was observed in repeated sprints in this group. The lower fatigue index of experienced athletes indicates that they can sustain repeated high-intensity runs better. Therefore, it is thought that there is a significant negative relationship between the fatigue index and end-of-season scores.

The 3000 m running test is one of the indicators of aerobic endurance, and when the results were analyzed, a significant and negative relationship was found between the test time and end-of-season competition scores ($r = -0.543$, $p = .011$). Experienced athletes had better test times. The average time was determined to be 10:29 min, with a minimum of 9:29 min and a maximum of 12:55 min. These values are lower than the average of 9:27 min for Swiss elite athletes. In this study, the equation developed by Aandstad for estimating VO_2max based on 3000 m times was used (Aandstad, 2021). According to this formula, the estimated VO_2max values of the participants in the present study ranged from 44.0 to 62.4 ml/kg/min, with an average of 55.8 ml/kg/min. In the literature, VO_2max values for elite orienteering athletes have been reported to range from 63 to 76 ml/kg/min [3]. This difference highlights the importance of training continuity at the international level of success. In summary, the results of the 3000 m running test are an indicator that indirectly reflects aerobic capacity, and it is thought that this capacity affects the ability to cope with both cognitive and physical loads.

There are various studies in the literature that examine the effect of experience on performance in orienteering. In the study conducted by Eccles, Walsh, and Ingledew, the visual attention characteristics exhibited by experienced and less experienced orienteering athletes were examined during the course. Participants' visual attention orientations were analyzed under the categories of map, environment, and movement (travel) using a head-mounted camera with audio recording capabilities; additionally, the moments when athletes were in motion or stationary were recorded. The research findings showed that experienced athletes looked at the map less frequently, but their frequency of looking at the map while moving was significantly higher, and the time they spent stationary was shorter (Eccles et al., 2002).

Similarly, a study conducted by Liu compared athletes with different experience levels and found that experienced athletes had shorter route planning time, longer duration and concentrated gaze distribution, therefore achieving higher route planning quality. It has also

been observed that they have significant cognitive advantages compared to inexperienced athletes in detecting important information. It has been stated that experienced athletes simplify their navigation processes along the course in terms of time, do not reduce the race pace while looking at the map, can solve navigation problems by anticipating them before reaching the target point, and thus do not need to stop to make decisions (Liu, 2019). The ability of an athlete to simultaneously focus on map, environment and movement elements during orienteering is an important indicator of cognitive capacity. In this context, it is necessary to select the relevant information from the map and compare it with the information received from the environment (Eccles et al., 2002, Pesce et al., 2007).

In the present study, it was found that aerobic endurance and athlete experience, measured by a 3000 meter running test, had significant effects on end-of-season performance. Aerobic endurance and experience stand out as the main components that improve performance. These findings show that training programs should be optimized by keeping these two factors in the foreground.

Conflict of Interest: There is no conflict of interest between the authors.

Statement of Contribution of Researchers:

1.Author: %50

2.Author: %50

Information about the Ethics Committee Permission: Responsibility for any violations that may arise in the work done belongs to the author. Ethics committee approval of the article was obtained with the decision of Eskisehir Technical University Ethics Committee dated 15.03.2021 and numbered 11418.

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