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A Study on the Association between Skiers' Body Fat Percentage and Their Jump and Sprint Performance

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Research Article

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Abstract

This study was conducted to analyse the correlation between elite skiers' body fat percentage (BFP) and their jump and sprint performance. From among different disciplines of snow sports (alpine skiing, cross-country skiing, snowboarding, ski jumping, and biathlon), a total of 40 (male) elite athletes with a mean age of 18.55±2.86 year, a mean height of 172.1±6.05 cm, and a mean body weight of 65.73±10.79 kg were included in this study, and their anthropometric (height, body weight, body mass index, and BFP) and performance (10-30 meters sprint and vertical/horizontal jump) measurements were taken. In order to determine the suitability of the data for normal distribution, the Pearson Correlation Coefficient test was used to analyse the correlations between variables upon assuming normal distribution by using the Shapiro-Wilk test. As a result, negative correlations were found between 10-30 m sprint and horizontal jump performances and the disciplines of cross-country skiing, ski jumping and biathlon. Further negative correlations were found between vertical jump and 30 m sprint in snowboard branch, while positive correlations were present between 10-30 m sprint and BFP in the disciplines of cross-country skiing, ski jumping and biathlon. However, there was also a strong negative correlation between horizontal jump and BFP in the discipline of ski jumping. It can be suggested that high BFP negatively affects the sprint and jump abilities of the athletes since the skiers' jump performance appears to decrease with the increased BFP, and likewise, their jump performance increases with the decreased BFP.
Keywords: Skiing, Vertical jump, Horizontal jump Sprint, Body mass index, Body fat percentage

Kayak Branşı Sporcularının Vücut Yağ Yüzdesi ile Sıçrama ve Sürat Performansları Arasındaki İlişkinin İncelenmesi

Öz

Bu çalışma elit düzeydeki kayak branşı sporcularının vücut yağ yüzdesi ile sıçrama ve sürat performansları arasındaki ilişkinin incelenmesi amacı ile yapılmıştır. Çalışmaya farklı kar sporu branşları (alp disiplini, kayaklı koşu, snowboard, kayakla atlama ve biathlon) kapsamında ortalama yaşları 18,55±2,86, ortalama boyu 172,1±6,05 cm ve ortalama vücut ağırlıkları 65,73±10,79 kg olan, toplam 40(erkek) elit sporcu dahil edilmiştir. Araştırmaya katılan sporcuların antropometrik (boy uzunluğu, vücut ağırlığı, beden kitle indeksi ve vücut yağ yüzdesi) ve performans (10-30 metre sprint ve dikey/yatay sıçrama) ölçümleri uygulanmıştır. Verilerin dağılıma uygunluğu, Shapiro-Wilk testinden yararlanılarak normal dağılım varsayıldıktan sonra değişkenler arasındaki ilişkilerin analizinde Pearson Korelasyon Katsayısı Korelasyon testi kullanılmıştır. Kayaklı koşu, kayakla atlama ve biathlon branşlarının 10-30 metre sprint ve yatay sıçrama performansları arasında negatif yönlü ilişkiler tespit edilmiştir. Snowboard branşı dikey sıçrama ile 30 m sprint arasında negatif yönlü ilişkiler tespit edilmiştir. Kayaklı koşu, kayakla atlama ve biathlon branşlarının 10-30 m sprint ile VYY arasında pozitif yönlü ilişkiler tespit edilmiştir. Kayakla atlama yatay sıçrama ile VYY değeri arasında negatif yönlü yüksek düzeyde ilişkiler tespit edilmiştir. Sonuç olarak, vücut yağ yüzdesinin fazla olması sporcuların sprint ve sıçrama yeteneklerini olumsuz yönde etkilemektedir. Vücut yağ yüzdesinin artması ile sporcuların sıçrama performanslarının azaldığı ya da yağ yüzdesinin azalması ile sporcuların sıçrama performanslarının arttığı görülmüştür.
Anahtar Kelimeler: Kayak, Dikey sıçrama, Yatay sıçrama, Sprint, Beden kitle indeksi, Vücut yağ yüzdesi

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INTRODUCTION

Skiing emerged as a consequence of the basic needs of people, and with the development of technology, it not only contributes to the tourism sector for entertainment purposes in the global sense, but has also become an Olympic sport for which a European Cup and a World Cup are held when considered in the professional sense (Aktaş, 2009). It comprises five main disciplines; cross-country skiing, biathlon, ski jumping, snowboarding, and alpine skiing. In addition, it can be performed at an elite level either as an individual sport or a team sport (Aktaş, 2009; Atasever et al., 2021). It is one of the multi-disciplinary sports containing many features. For this reason, there is a need for performance tests of elite skiers apart from their training on snow and conditioning training in line with the results of these tests (Yu et al., 2022).

Skiing is one of the endurance sports with high technical and physiological challenges due to such reasons as training intensity and duration, which can constantly vary in the setting where it is performed (medium/high altitude, cold weather, etc.), and due to the coordinated working principles of the upper and lower extremities. In this context, since performing only the technical exercise on snow remains insufficient, further trainings are also needed in addition to the training on the snow in order to develop gross motor skills such as balance, coordination, strength, speed, endurance, and mobility, which all form the basis of these technical practices and help develop the physical and physiological characteristics necessary for this branch of sport. Such trainings include field and fitness exercises without being limited to any seasonal or time-of-day-related factors (Schenk et al., 2011).

Among the different disciplines of skiing are branch-specific training requirements. The kind of training for ski jumping, for example, can be determined by exercises including explosive power (jumping), quickness and flexibility, as well as by considering body composition and physical fitness (Rybakova et al., 2020). Known as an endurance sport, biathlon refers to the sport combining cross-country skiing and rifle shooting, and at the same time, requires maximum speed and strength, as far as skating sprint competition performances are concerned (Bahar, 2017; Kreivėnaitė, 2012). In addition to the physiological profiles of the alpine skiers, other performance parameters include muscle strength, anaerobic power-endurance, agility, balance, and flexibility (Andersen & Montgomery, 1988). For cross-country skiing, on the other hand, research has shown that the capability of the skiers to continuously producing power in the shortest time depends on their high physical fitness, endurance, balance, strength, speed, quickness, and maximal oxygen consumption capacity (Millet et al., 1998). All forms of skiing are generally performed against the time and distance. In this sense, the training programs prepared to maximize the performance of the skiers should include sprint and explosive power (Aktaş, 2009).

Jump force is defined as an athlete’s jump to the highest possible distance horizontally or vertically. Considering the jumping movement, in particular, leg strength and jump force are evaluated together, since the flexor and extensor muscles of the lower extremity are influential in such a movement (Şimşek et al., 2007).

Sprint is defined as the speed of the whole body or parts of the body while performing a movement, or the ability to move a part of the body at high speed (Sevim, 1997). It is one of the fundamentals of performance and includes very complex features such as movement and reaction sprint. Despite the fact that sprint depends on innate characteristics, a little improvement can still be achieved through practical techniques and development of coordination (Gökhan et al., 2015). It is also known that jumping performance is closely related to sprint performance. Sprint training is, therefore, particularly essential for skiing (Jinhui et al., 2021). It is known that jumping performance is closely related to speed performance (Perez-Gomez et al., 2008; Young et al., 1995). Speed and jumping ability contribute significantly to athletes' ability to demonstrate their main performance. It is important to be able to reach peak speed performance during sprints (Hoff & Helgerud, 2004).

Depending on the branch of sports, athletes naturally have different heights, weights, fat and muscle mass (Şimşek et al., 2013). Given that skiers are exposed to extremely harsh environmental conditions, the cycle of nutrition and fluid loss is of great importance to them (Meyer et al., 2011). Athletes who do endurance exercises are exposed to more water and nutrient loss as the cold air is dry (Sue-Chu, 2012). The physical characteristics of the human body indicate that body composition and somatotype characteristics are likely to be related to sports performance (Claessens et al., 1991). While low BFP is generally recommended for good performance in activities that require running and jumping, muscle mass is also considered to be an advantage in activities that require strength and power. However, excess BFP negatively affects sports performance. Due to the burden of carrying the inactive tissues, athletes with a high BFP are observed to consume more energy and get tired in a relatively short time during endurance performance (Eston & Reilly, 2001). The relationship between body composition and performance is a complex issue and there are many studies on this subject (Hazar & Akyol, 2019). BFP refers to the percentage of the body fat of an athlete or any individual; it is often used to determine the body composition of athletes (Perez-Gomez et al., 2008). It is important for athletes to have a suitable physical fitness to perform at a high level, and thus, BFP plays an important role in performance.

This study aimed to examine the relationship between the BFPs of skiers and their vertical and horizontal jump as well as sprint performances due to remarkable research findings such as the presence of a relationship between the BFP and performance parameters, and the fact that performance differences are related to the BFP.

METHOD

Study Design

Engaged in different forms of skiing (alpine skiing, snowboarding, cross-country skiing, biathlon and ski jumping), 40 male (8 athletes in five different sports) skiers competing at the elite level in the age group of 15-23 (mean age 18.55±2.86 years, mean height 172.1±6.05cm, and mean body weight 65.73±10.79 kg) participated in this study. Criteria for inclusion in the study; The participants will be determined as not having any systemic disease, not having a lower extremity injury, and volunteering to participate in the study. Athletes who do not meet these criteria will not be included in the study. The skiers signed the volunteer consent forms after being informed about the tests to be performed. Measurements were taken before the ski season.

Ethical Approval

The study was carried out in accordance with the Declaration of Helsinki. In addition, the method of this study was in conformity with the framework of "Higher Education Institutions Scientific Research and Publication Ethics Directive". Ethics committee approval of the study was obtained from Erzurum Technical University, Scientific Research and Publication Ethics Committee (25/05/2023-11 numbered article).

Data collection tools

The skiers' heights were measured with a stadiometer with a precision of ±1mm (Holtain, UK). Their weight, BMIs and BFPs were measured with the Tanita brand (BC, 418 Tanita, Japan) 100-gram precision body composition analyzer. A standardized warm-up protocol of 15 minutes was performed by the skiers on the grass field. Sprint performances were measured in the form of 10 and 30-meter sprint tests with two repetitions at 3-minute intervals by using a voit brand stopwatch to record the best time. Based on this, it can be concluded that the participants' best sprint time was measured. Vertical jump performances were assessed in cm on a marked wall, and the tests were repeated two times at 3-minute intervals. The best jump distance was recorded and evaluated as the vertical jump performance of the athletes on the same days. In general terms, for the standing long jump (horizontal jump) performances, the subject tries to jump a long distance behind the marked line using maximal effort with both feet. The distance between the take-off point and the nearest trace left by the skier to that point is measured in meters (Sevim & Şengül, 1987)

Data analysis

SPSS 26.0 package program was used for data analysis, in which the conformity to the normal distribution was determined by using the Shapiro-Wilk test, and it was found that all the data met the assumptions of normal distribution. The Pearson's correlation coefficient was calculated, and scatter plots were used to determine the correlations between variables. The statistical significance was taken as $p<0.05$.

FINDINGS

The statistical findings regarding the participants' age, height and weight, and the arithmetic mean and standard deviation values are given in Table 1.

Table 1. Descriptive data of the skiers

	Biathlon (N=8) X̄±S	Cross Country (N=8) X̄±S	Alpine Skiing (N=8) X̄±S	Snowboarding (N=8) X̄±S	Ski Jumping (N=8) X̄±S	Total (N=40) X̄ ±S
Age	17.62±2.56	19±2.13	17.37±1.18	18.87±3.04	19.87±4.35	18.55±2.86
Body Weight (kg)	61.5±6.74	72.38±7.61	68.87±12.33	70.37±10.94	55.5±6.86	65.73±10.79
Height (cm)	167.37±5.73	175±6.84	171.75±6.47	174.12±3.75	172.25±5.36	172.1±6.05
BMI	21.87±3.31	23.37±1.68	23.12±3.39	23.25±2.76	18.37±1.50	22±3.16
%BFP	9.73±3.10	12.18±2.97	13.75±5.36	13.25±2.86	8±3.58	11.38±4.14
10m Sprint(sec)	1.83±0.10	1.83±0.10	1.73±0.07	1.81±0.12	1.78±0.14	1.80±0.11
30m Sprint(sec)	4.35±0.36	4.35±0.17	4.25±0.18	4.3±0.16	4.26±0.27	4.30±0.23
Vertical Jump(cm)	48±4.72	44.81±5.707	52.25±7.13	51.43±7	62.25±3.37	51.75±8.07
Horizontal Jump (cm)	2.44±0.08	2.43±0.08	2.50±0.25	2.35±0.24	2.90±0.23	2.52±0.27

*p<0.05; BMI: Body Mass Index; %BFP: Body fat percentage

As can be seen in the given table, the ski jumpers' BMI is lower than those who take part in other branches in the sport of skiing. The skiers (i.e., those engaged in alpine skiing, snowboarding, cross-country skiing, biathlon, and ski jumping) in the present study had a mean age of 18.55±2.86 years, a mean body weight of 65.73±10.79 kg, and a mean height of 172.1±6.05.40. In addition, the total BMIs and BFPs of the skiers were 22±3.16 and 11.38±4.14, respectively. For the performance metrics, 10 m sprint averages were measured as 1.80±0.11 seconds, 30 m sprint averages as 4.30±0.23 seconds, vertical jump height averages as 51.75±8.07 cm, and horizontal jump height averages as 2.52±0.27 cm.

Table 2. Body fat percentage and performance measurement values of skiers

Branches	Variables	BFP%	Sprint 10m	Sprint 30m	Vertical Jump	Horizontal Jump
Cross-country skiing	BFP%	1				
	Sprint10m	.724*	1			
	Sprint30m	.715*	.942**	1		
	Vertical Jump	-0.620	-0.523	-0.522	1	
	Horizontal Jump	-0.430	-.728*	-.791*	0.618	1
Alpine skiing	BFP%	1				
	Sprint10m	0.381	1			
	Sprint30m	0.611	0.665	1		
	Vertical Jump	0.106	-0.325	-0.277	1	
	Horizontal Jump	-0.309	0.213	-0.410	0.090	1
Snowboarding	BFP%	1				
	Sprint10m	-0.494	1			
	Sprint30m	0.366	0.521	1		
	Vertical Jump	-0.099	-0.401	-.766*	1	
	Horizontal Jump	-0.268	-0.144	-0.416	0.029	1

**p<0.01*p<0.05; %BFP: Body Fat Percentage

Table 2. Continued…

Branches	Variables	BFP%	Sprint 10m	Sprint 30m	Vertical Jump	Horizontal Jump
	BFP%	1				
	Sprint10m	.934**	1			
Ski Jumping	Sprint30m	.946**	.974**	1		
	Vertical Jump	-0.437	-0.691	-0.646	1	
	Horizontal Jump	-.866**	-.960**	-.953**	.778*	1
	BFP%	1				
	Sprint10m	.862**	1			
Biathlon	Sprint30m	0.172	0.576	1		
	Vertical Jump	-0.521	-0.536	-0.301	1	
	Horizontal Jump	-0.593	-.805*	-0.643	0.253	1
	BFP%	1				
	Sprint10m	.321*	1			
General	Sprint30m	.566**	.805**	1		
	Vertical Jump	-.325*	-.392*	-.427**	1	
	Horizontal Jump	-.549**	-.351*	-.449**	.564**	1

**p<0.01 *p<0.05; %BFP: Body Fat Percentage

Table 2 presents the correlation values of the BFP, 10-30m sprint, and vertical and horizontal jump measurements. The analysis of the correlation between the BFP and horizontal jump performance and sprint performance among cross-country skiers revealed negative correlations between the skiers' BFP and their horizontal jump performance and 10-30-meter sprint performances (r=-0.728, p<0.05; r=-0.791, p<0.05, respectively). In the discipline of ski jumping, on the other hand, strong negative correlations were found between the skiers' BFP and their horizontal jump performance and 10-30meter sprint performance (r=-0.960, p<0.01; r=-0.953, p<0.01, respectively). Moreover, in the discipline of biathlon, negative correlations (r=-0.805, p<0.05) were similarly found between the BFP and horizontal jump performance and 10-meter sprint performance.

When the skier's BFPs were examined in relation to the correlation with their vertical jump and sprint performances, negative correlations (r=-0.766, p<0.05) were found between the BFPs and their vertical jump and 30 m sprint performance in the discipline of snowboarding.

Moreover, the analysis of the correlations between the skiers' BFPs and their sprint performances shows positive correlations (r=0.724, p<0.05; r=0.715, p<0.05) between the 10 m and 30 m sprint performances and the BFPs of the skiers in the discipline of cross-country skiing. In the ski jumping branch, on the other hand, strong positive correlations (r=0.934, p<0.01; r=0.946, p<0.01) were found between 10 m and 30 m sprint performances and the BFPs. Similarly, strong positive correlations (r=0.862, p<0.01) were found between 10 m sprint performance and the BFPs in the biathlon branch.

When the correlation between skiers' jump performances and the BFPs were examined, a strong negative correlation (r=-866, p<0.01) was found between the skiers' horizontal jump performances and BFPs in ski jumping.

Figure 1 and Figure 2 presents the scatter plots for the relationship between the skiers' BFPs and performance parameters.

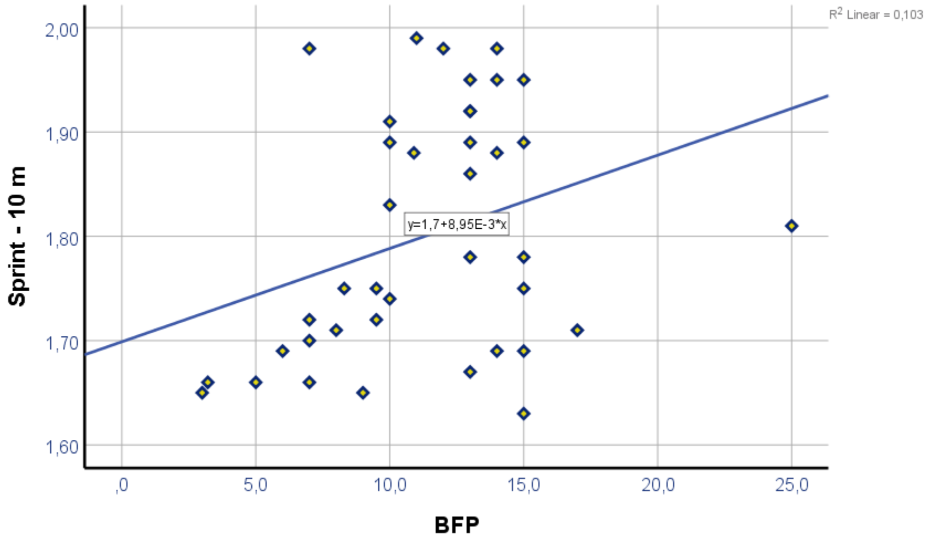

Figure 1. Scatter-plot: BFP and 10m (I)

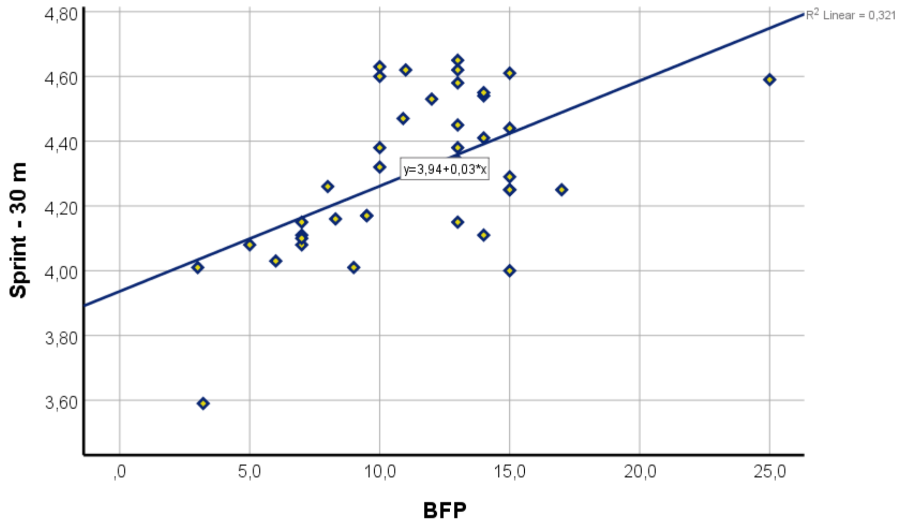

Figure 2. Scatter-plot: BFP and 30m (II)

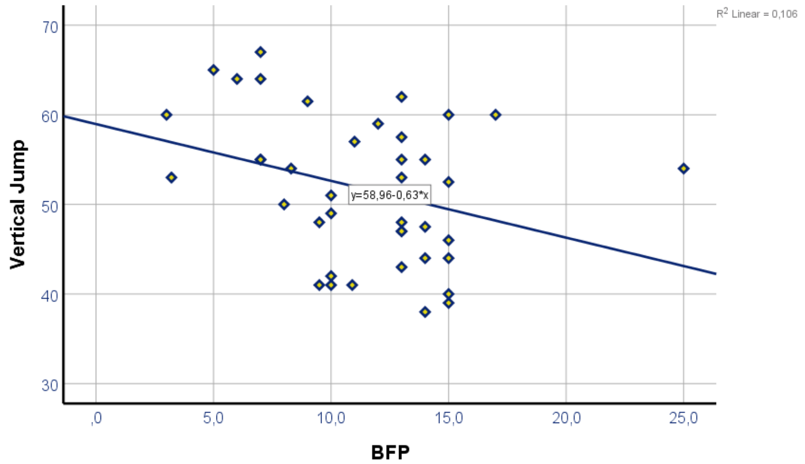

Figure 3. Scatter-plot: BFP and Vertical Jump (III)

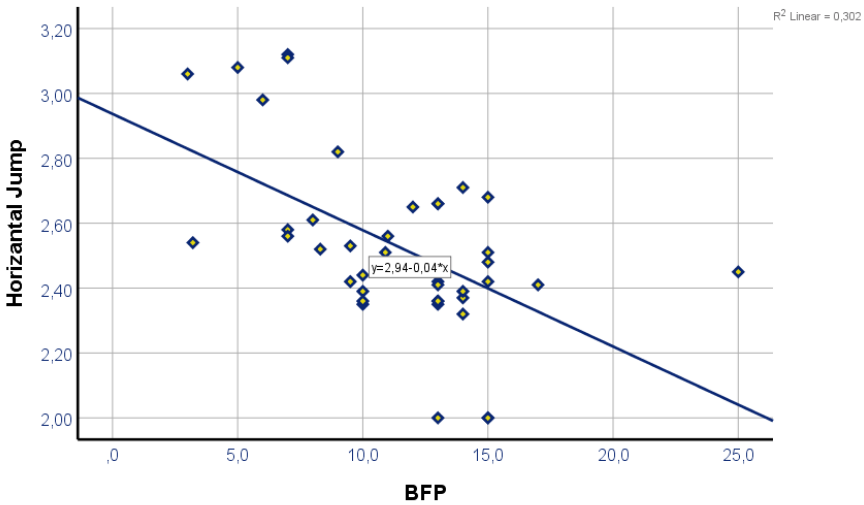

Figure IV. Scatter plot: BFP and Horizontal Jump (IV)

Figure I-II shows the scatter plots of the positive relationships between the skiers' BFPs and their 10-30m sprint performances. As can be seen in the graph, as the BFPs increase, so do the sprint times, which is a situation resulting in a decreased sprint performance. Figure III-IV represents the scatter plot of the negative relationship between the skiers' BFP and their vertical/horizontal jump performances. According to the given graphs, as BFP increases, vertical/horizontal jump performance decreases.

DISCUSSION AND CONCLUSION

This study examined the correlations between the elite skiers' BFP and their jump and sprint performances. The results indicated statistically significant weak and moderate positive correlations between the BFP and sprint performances, for it was found that as the BFPs increased, so did the sprint times. It also appears that the athletes with a lower BFP generally exhibited better sprint performances. The results also indicated the presence of a negative weak and moderate correlation between the BFP of the athletes and their vertical/horizontal jump performance. It also appeared that the athletes' jumping performance decreased with increased body fat percentage, and likewise, their jumping performance increased with decreased BFP.

Research shows that the BFP of cross-country skiers with FIS score of 22.5 ± 12.0 in the world rankings was found as 8.9 ± 2.5, and that of those with 100.6 ± 45.8 at the national level as 9.8 ± 1.5 (Sandbakk et al., 2011). The BFP of the cross-country skiers at the same level included in our study was measured as 12.18±2.97. In another study conducted with elite ski jumpers, the skiers' BFP was found to be 8.6±1.9 (Rankinen et al., 1998). Given the rate of 8±3.58 as the BFP of the ski jumping athletes included in our study, our results were found compatible with the previously mentioned study. Another study conducted with a number of alpine skiers reported the BFPs of international level athletes as 11.48±2.74 and that of the national level athletes as 8.92±2.96, while that of the regional level athletes was found 9.28±1.26 (Ferland & Comtois, 2018). The BFP of the alpine skiers in our study was found to be 13.75±5.36, which seems higher than that reported in similar studies. In a study conducted with a focus on the discipline of snowboarding, the snowboard cross athletes' BFPs were measured as 11.9±3.5, whereas the alpine snowboard athletes' BFP were found as 13.8±3.7 (Vernillo et al., 2016). Likewise, the snowboard cross athletes' BFP in our study was 13.75±5.36, which is similar to that of the alpine snowboard athletes.

Moreover, a study conducted with cross-country skiers reported that the BFP was positively correlated to sprinting, and that cross-country skiers needed to have a body composition with a low BFP (Stöggl et al., 2010). In a similar sense, it is known that as amateur football players' BFPs and BMIs increases, so do their 10 m and 30 m sprint times. In such a case, excess BFP and BMI cause the body to carry extra load, which negatively affects the sprint (Aktaş & Aslan, 2018). Similarly, having a high BFP negatively affects the footballers' sprinting times (Çelik et al., 2022). Furthermore, a study on swimmers reported significant decreases in the BFP and 20 m sprint running measurement parameters compared to pre-exercise (Gökhan & Kürkçü, 2011). Another study conducted with football players determined that there were positive moderate correlations between the BFP and 10-30m sprint performance, and statistically significant, strong positive relationships between the BFP and 10m and 30m sprint performances (Cerrah et al., 2011). Consequently, it can be suggested that athletes with low BFPs can perform better than those with high BFPs (Damayanti & Adriani, 2021). In our study, positive correlations between BFP and 10 and 30 meters sprint values in cross-country skiing and ski jumping branches [($r=0.724$, $p<0.05$); ($r=0.715$, $p<0.05$), ($r=0.934$, $p<0.01$); ($r=0.946$, $p<0.01$)] respectively supports the results reported in the literature. In addition, the presence of positive correlations ($r=0.862$, $p<0.01$) between BFP and 10-meter sprint value in the biathlon branch also supports the relevant results provided in the literature. Another study conducted on elite sprinters examined the relationship between body composition and sprint degrees, concluding that reducing the BFP positively affects the sprint degree (performance), and emphasizing that the higher the BFP, the longer the sprint time. Therefore, sprint performance decreases (Abe et al., 2020). As the BFP increases, it limits the body's range of motion, resulting in decreased performance. As a fatty body causes more energy expenditure and slower movement, the sprint time is prolonged. For this reason, a high level of BFP will negatively affect performance in sports, as well as sprint and jump abilities.

In the same connection, a study conducted on university students being trained in the discipline of football reported a moderately significant positive correlation between the BFP and 30m sprint (Anwar & Noohu, 2016). Another study conducted on futsal players found a statistically significant, strong positive correlation between the BFP and 20m sprint performance (Damayanti & Adriani, 2021). However, another study on football players reported a weak positive correlation between the BFP and 50m sprint (Hyka et al., 2017). In the study examining the results between the body compositions and sprint performance of football players, a positive moderate correlation was found between the 10-30m sprint performance and the BFP and mass (Aktaş & Aslan, 2018). A study conducted on basketball players reported a statistically significant relationship between the BFP and 20m sprint performance (Cengiz & Savaş, 2009). In our study, when the body compositions and sprint performances of the athletes are examined, it can be suggested that the positive correlation between the skiers' 10-30m sprint performances and the BFPs in the cross-country skiing supports the results reported by the other studies presented in the relevant literature. In addition, strong positive correlations were found between 10 m and 30 m sprint performances and BFPs of ski jumping athletes, who ended up having the lowest BFPs compared to other athletes of winter sports included in the present study. The fact that the athletes of biathlon had the second lowest BFPs of all the other values detected for the given disciplines in our study and that there was a positive correlation between 10 m sprint performance and BFP values also support the results presented in the relevant literature.

Another notable aspect in this study is that it also revealed a statistically significant relationship between the components of body composition and vertical jump (Silvestre et al., 2006). In this context, research shows that there was a significant relationship between the BFPs and vertical jump performances of the elite basketball players before and after the preparation period (Cengiz & Savaş, 2009). Furthermore, a statistically significant, moderate negative correlation was found between the BFPs and vertical jump performances in a study conducted with football players studying this discipline at university (Anwar & Noohu, 2016). Another study concluded that jumping performance was negatively affected by the increased BFP (Atakan et al., 2017). In another study on the football branch, a strong negative correlation was found between the BFP and vertical jump performance (Esco et al., 2018). Moreover, a study examining the correlation between body composition and performance parameters of young football players revealed that low BFP resulted in better vertical jump performance (Gameiro et al., 2018). In the light of the findings of our study, the correlation between the jumping performances of the athletes and the BFP values pointed to the fact that there is a high negative correlation ($r=-866$, $p<0.01$) between the horizontal jump performance and the BFP value in the ski jump branch, which is in support of the results reported in the literature. In addition, there is a negative correlation between vertical jump and BFP in the snowboard branch. On the basis of the results of our study, we concluded that there is a negative correlation between vertical jump and the BFP and that the vertical jump performance decreases with the increased BFP. This relationship shows that athletes with a lower BFP have more muscle mass, and therefore, better vertical jump ability.

Research has shown that the horizontal jump distance was found to be 2.03 m before plyometric training performed by male basketball players (14-15 years) and 2.11 m after training (Öztin et al., 2003). One study reported that the height of the vertical and horizontal jumps decreased as a result of the increased BFP, depending on the body weight (Koç & Aslan, 2010). When the correlations between vertical jump and sprint performances were examined in our study, negative correlations ($r=-0.766$, $p<0.05$) were found between vertical jump and 30 m sprint performance of snowboard athletes. The results of similar studies conducted for different disciplines seem to be in conformity with those of this study, considering that the vertical and horizontal jump performance decreased as the BFPs increased (Duncan et al., 2006; Fleck et al., 1985). Of all the correlations revealed in this study, the negative correlations between horizontal jump and sprint performances in cross-country skiing, ski jumping and biathlon branches were ($r=-0.728$, $p<0.05$); ($r=-0.791$, $p<0.05$), ($r=-0.960$,$p<0.01$), ($r=-0.953$, $p<0.01$), and ($r=-0.805$, $p<0.05$), respectively, in a way that supports the results presented in the literature. The analysis of the relationships between horizontal jump and sprint performances in our study indicated negative correlations between the skiers' BFPs and their said performances in the disciplines of cross-country skiing, ski jumping and biathlon. Among the five branches, the three with the athletes having the lowest BMIs were ski jumping, biathlon and cross-country skiing, respectively. Since ski jumping requires flying in the air at high speeds, body composition and nutritional status are one of the most critical factors. Due to gravity, a lower BMI increases the chances of achieving longer jump distances (Oggiano & Setran, 2009). For better performance, ski jumping athletes need to maintain their body weight in order to increase their performance, and therefore, they turned out to have the lowest BMIs in our study. A high percentage of fat means that most of the body weight is made up of fat, resulting in poorer performance in activities involving body repositioning (Cooper, 1968). Increased body fat limits the mobility and may result in decreased performance. For this reason, it is suggested that having a high BFP negatively affects sprint and jumping ability.

RECOMMENDATIONS

As a result of our study, it can be suggested that a high BFP negatively affects the sprint and jumping abilities of the athletes. In order to achieve better performances, the recommendations may include decreasing the BFP, increasing the muscle mass, and achieving a better body composition in general, as well as improving the outcomes of performance parameters. There is a need for studies examining the effects of fat burning training on physical performance on a branch-based basis. In addition, the correlation between the BFP and performance parameters may be kept track of before, during and after the season. The results obtained are expected to contribute to understanding the impact of body composition on performance and to optimizing the training and nutrition programs of athletes.

Conflict of Interest: There is no personal or financial conflict of interest within the scope of the study.

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Ethics Committee Approval

Committee Name: Erzurum Technical University, Scientific Research and Publication Ethics Committee
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