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Research article

Examining of some physical and physiological parameters of 10-18 years old male skiers to seasonal cycles

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Abstract: Skiing can be identified as a branch with the most important representative power of winter sports. Further, it has been characterized by high popularity and population, branching off in itself. During the year, different physical performance and physiological indicators are sometimes encountered in athletes depending on seasonal cycles, training levels, and living conditions. The aim of this study is to examine some physical performance parameters and the determined hormone levels to seasonal cycles. **Methods:** 15 male skiers with a mean age of 14.53±2.61 (years), a mean height of 158.53±9.66 (cm), and a mean body mass of 54.20±10.85 (kg) participated in the study. The information about participants' age, height, and body mass was determined by standard methods. Various measurement tools were used including a digital hand dynamometer (TKK 5401) for hand grip strength, a digital dynamometer (TKK 5402) for back and leg strength, a jump meter (Takei TKK 5406) for vertical jump height, and an electronic hand spirometer (firstMED) for respiratory functions. The Wingate anaerobic power test (Monark 894 E bicycle ergometer) was performed to determine the anaerobic power level. Additionally, to determine somatotypes (ectomorph, mesomorph, endomorph) and body fat percentage; skinfold caliper (Holtain), tape measure, and digital caliper (Holtain) were respectively utilized for skinfold thickness measurement, circumference measurements, and diameter measurements. Blood samples (hemogram test, vitamin D, cortisol, and testosterone to be checked) were taken from the antecubital vein in the sitting position. From the blood samples, serum plasma was separated and preserved by centrifugation (+4o) and all samples were analyzed at once. All tests were performed once in September, December, March, and June at an altitude of 2,000 and in pre-season and mid-season. The data were analyzed through IBM SPSS 24.0 package program. Shapiro-Wilk was used to determine the distribution of the data, descriptive and frequency analysis was used to determine the mean of the variables, and one-way analysis of variance (ANOVA) was used to determine the differences between measurements. The results were presented as arithmetic mean and standard deviation ($\bar{X}$±Ss). **Results:** In 10-18 years old male skiers, it was determined that vitamin D reached its highest level in autumn, testosterone in summer, and cortisol in winter. In the inter-test comparison results, significant differences were determined in the vertical jump, right and left-hand grip strength, leg strength, testosterone, vitamin D, HCT, FVC, FEV1, and anaerobic power parameters. **Conclusions:** The results of the study have mostly supported the literature.

Keywords: vitamin D; testosterone; cortisol; anaerobic power; respiratory functions

1. Introduction

Skiing has become indispensable in the winter months. It has served as a tourism tool that increases the population of regions that experience intense winter months. Skiing has been performed at low-middle and high altitudes due to its environment. For this reason, it requires a certain time for both physical and physiological adaptation, which makes you feel the cold weather effect. It is generally preferred as a performance sport by people living in regions that meet the relevant conditions.

The physiological responses of organisms may differ depending on the seasonal cycles throughout the year. Particularly, concerning a circadian (biological) rhythm, the body's hourly, daily, and monthly responses are different.

Today, vitamin D deficiency, the most common vitamin deficiency in humans, has been influenced by all life conditions; but also it affects daily life (weakness, reluctance, etc.) and obstructs the loss of weight by distorting many systems of the body directly or indirectly.

Vitamin D acts on bone formation and the balance of calcium and phosphorus minerals in the serum. Also, it is considered an antirachitic vitamin and calciferol. It has an antirachitic effect by facilitating the absorption of calcium and phosphorus from the intestine and stimulating the reabsorption of phosphorus from the kidneys. Cholecalciferol (vitamin D type) is formed from 7-dehydrocholesterol in the malpygium layer of the skin by the action of UV rays with a wavelength of 290-320nm. Vitamin D is taken as ergocalciferol and cholecalciferol by diet. Ergocalciferol and cholecalciferol are similarly metabolized. They hormonally impact receptors in the kidney, intestine, osteoblasts, parathyroid pancreatic islet cells, brain cells, and mammary epithelium. Furthermore, vitamin D directly influences bone mineral metabolism. Together with calcitonin and parathormone, it provides calcium and phosphorus balance in body fluids and tissues. Similarly, vitamin D enables immunomodulation (prevention of autoimmune diseases) and regulation of cell proliferation (prevention of malignancies) [1].

Deficiency is defined as 25 (OH) D3 (25-hydroxyvitamin D_3/calcidiol), the clearest indicator of vitamin D, is less than 50 nmol/L (~ 20 ng/mL). Parameters including changes in vitamin D binding globulin, seasonal changes, ethnic differences, and body composition can affect normal levels of vitamin D [2].

The effects of vitamin D on muscle are less well-known. Clinically, people with severe vitamin D deficiency experience muscle weakness, pain, and hypotonia. Through the microscope, changes in muscle fiber size are determined by preferential atrophy of type 2 muscle fibers. Electromyography (EMG) has reported reduced motor unit action potentials in patients with vitamin D deficiency [1,3].

The crucial effects of vitamin D on skeletal muscle have been debated for decades. The answer begins with the vitamin D receptor (VDR), a cognate nuclear receptor, to which the active hormone 25-hydroxy D binds to exert both genomic and non-genomic effects in cells. The VDR is the mode of study in which vitamin D exerts its diverse effects in physiology, from a central role in calcium and mineral homeostasis to non-classical effects on cell division, tissue pleiotropy, fibrosis, and immune modulation [4].

It has been reported that VDR makes its first appearance in early embryonic life (i.e., 13th day in rats) and is initially expressed in the mesoderm, the embryonic tissue that forms the musculoskeletal system [5].

Testosterone is an anabolic steroid. While interacting with androgen receptors (AR) in skeletal muscle, the more potent dihydrotestosterone (DHT) has been reported to act primarily in sex-related tissues, with a possible secondary role in skeletal muscle [6].

Genomic androgen/AR binding has been reported to alter the expression of nearly 100' genes, most of which are involved in the regulation of skeletal muscle structure, fiber types, metabolism, and transcription [7].

Studies support that androgens increase protein synthesis and decrease catabolism and autophagy [8]. DHT is associated with skeletal muscle content and muscle strength [9]. It has also been reported to produce similar increases in testosterone replacement, lean mass and muscle strength, with or without 5α-reductase inhibitors (dutasteride or finasteride) [10,11]. Therefore, it is currently unclear whether DHT is more anabolic in skeletal muscle than testosterone alone.

Testosterone performs multiple er-gogenic, anabolic and anti-catabolic functions in skeletal muscle and neuronal tissue. This leads to increased muscle strength, power, endurance and hypertrophy [12]. It has been reported that androgens can be stimulant with exercise in men [13].

Considered from this perspective, androgens may mediate protein synthesis (in skeletal muscle) and resistance exercise adaptation [14].

Testosterone may be anti-catabolic by reducing glucocorticoid receptor (GR) expression and interfering with cortisol binding, or the AR-testosterone complex may compete with the cortisol-GR complex for Cis-element binding sites on DNA [15]. In addition to anabolic hormones, glucocorticoids, particularly cortisol, have a significant effect on human skeletal muscle [16].

During stable physiological conditions, circulating cortisol exhibits a circadian rhythm, peaking in the morning and gradually decreasing throughout the day, reaching its lowest levels around midnight [17]. Cortisol levels are regulated at both a systemic and tissue level to maintain glucocorticoid homeostasis. Endogenous cortisol levels are controlled systemically by the hypothalamic-pituitary-adrenal axis and locally by the action of 11b-hydroxysteroid dehydrogenase enzymes [14].

In the periphery, the cellular response to glucocorticoids; It has been reported to differ according to cell type [18,19], cell cycle stage [18] and exposure to stress [20].

In skeletal muscle, cortisol is effective in regulating energy homeostasis and metabolism [21]. During exercise, it increases metabolic substrates, maintains immune cell activity and vascular integrity [22].

It has been reported that if the stress is high (scope/intensity) during the application period, the cortisol response may also reach the highest levels [23,24].

Following acute exercise, tissue sensitivity to glucocorticoids, which inhibit muscle inflammation, cytokine synthesis, and muscle damage, is high. The reduced sensitivity of monocytes to glucocorticoids 24 hours after exercise may act to protect the body from prolonged, exercise-induced cortisol secretion [22].

Inactivation of cortisol in cortisol may act as a different mechanism to protect tissues and cells from the (harmful) effect of exercise-induced cortisol. Accordingly, inactivation of cortisol by cortisone may be another means of adaptation to exercise for athletes [25].

The aim of this study is to examine some physical performance parameters and selected hormone levels according to seasonal cycles.

2. Materials and Methods

2.1. Participants

15 men between the ages of 10-18 (mean age 14.53±2.61) who were involved in skiing as competitors participated in the study.

2.2. Research Place and Time

The study was carried out in a ski resort (also sports camp center) at an altitude of 2,000m.

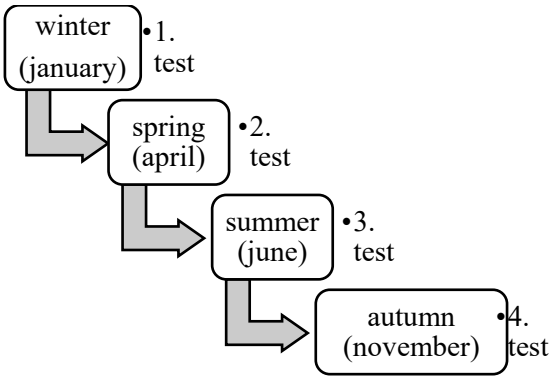


Figure 1. Physical and physiological measurement times

2.3. Physical Measurements

Physical Measurements: Participants' age, height and body mass information were determined by standard methods. Hand grip strength was measured with a digital hand dynamometer (TKK 5401). Back and leg strength were measured with a digital dynamometer (TKK 5402). Vertical jump height was measured with a Jumpmeter (Takei TKK 5406), and respiratory functions were measured with an electronic hand spirometer (firstMED). The Wingate anaerobic power test (Monark 894 E bicycle ergometer) was performed to determine the anaerobic power level. In the determination of somatotypes (ectomorph, mesamorph, endomorph) and body fat percentage (BYY); Skinfold caliper (Holtain) was used for skinfold thickness measurement, tape measure was used for circumference measurements, and digital caliper (Holtain anthropometric set) was used for diameter measurements and was calculated with formulas [38,39,40].

2.4. Collection of Blood Samples and Biochemical Analysis

Blood samples (including hemogram test, vitamin D, cortisol and testosterone) were taken from the antecubital vein in the sitting position. From the blood samples, serum-plasma was separated and preserved by centrifugation (+4o), and all samples were analyzed in one go by mass spectrometry (LC-MS/MS).

2.5. Data Analysis

The data obtained from the research were analyzed in the IBM SPSS (Statistical Package for the Social Sciences) 24.0 package program. Shapiro-wilk was used to determine the distribution of the data, descriptive and frequency analysis was used to determine the mean of the variables, and one-way analysis of variance (ANOVA) was used to determine the differences between measurements. Bonferroni correction was made to control the Type I error. Results were given as arithmetic mean and standard deviation ($\bar{X}$±Ss), mean difference (MD), smallest observation value (Minimum) and largest observation value (Maximum). Significance level was accepted as $p<0.012$ for 4 repetitive tests.

3. Results

Fifteen men with a mean age of 14.53±2.61 (years), a mean height of 158.53±9.66 (cm), and a mean body mass of 54.20±10.85 (kg) participated in the study.

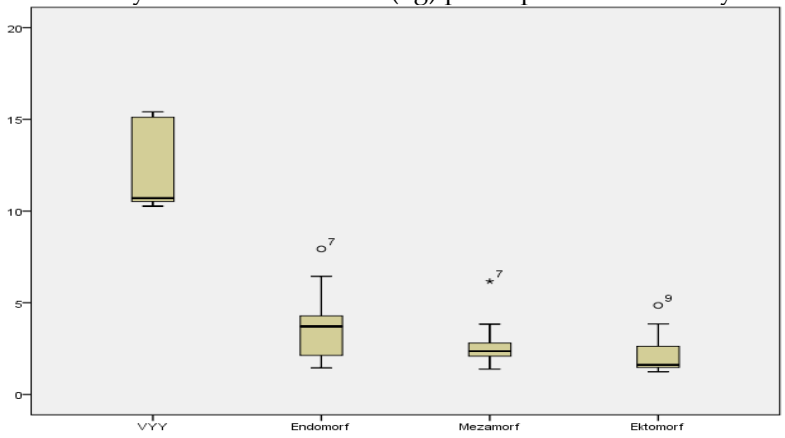


Chart 1. Body Profile

When the chart (1) was examined, the mean BPM of the participants was determined as 12.12±2.28%. It is seen that their somatotypes are predominantly endomorphic (3.55±1.85). Further, mesamorphic (2.70±1.15) and ectomorphic (2.23±1.10) structures are closely related.

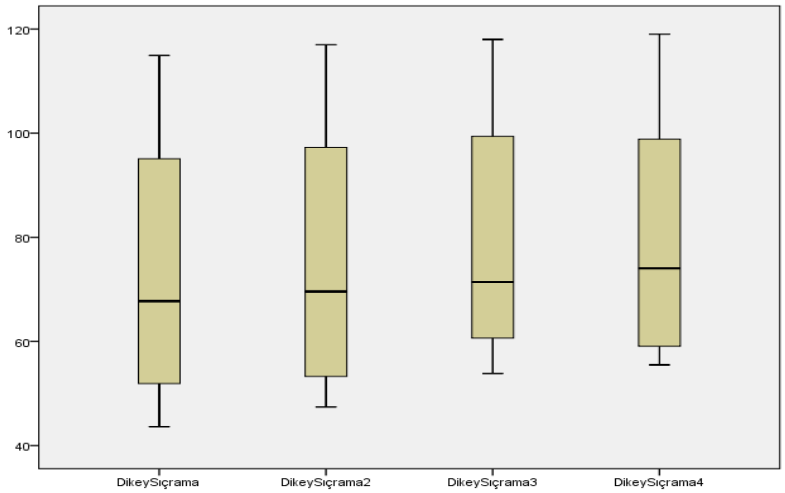
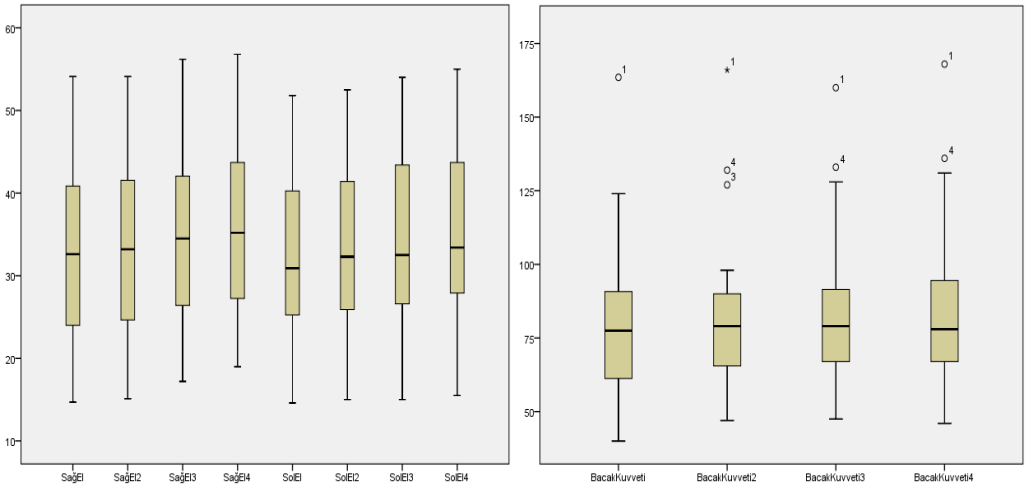
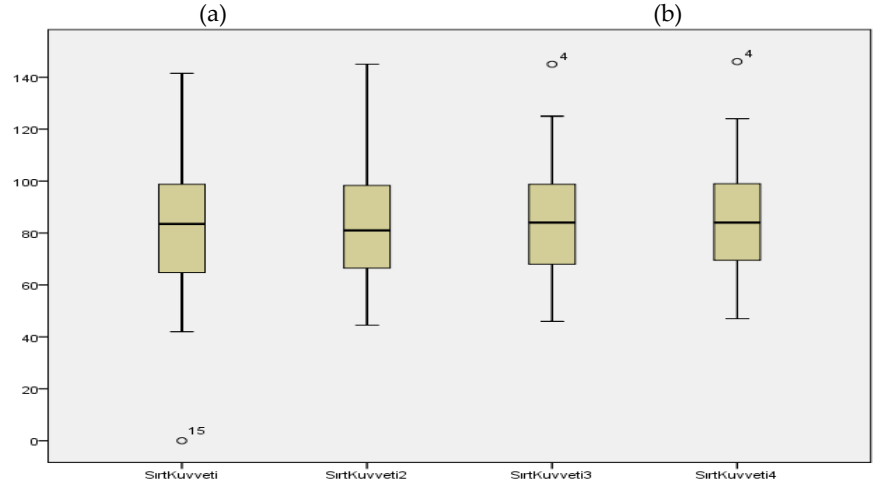


Chart 2. Vertical jump

When Chart (2) is examined, it is seen that the highest average in vertical jump performance was reached in the 4th test (79.85±23.29 kgm/s).

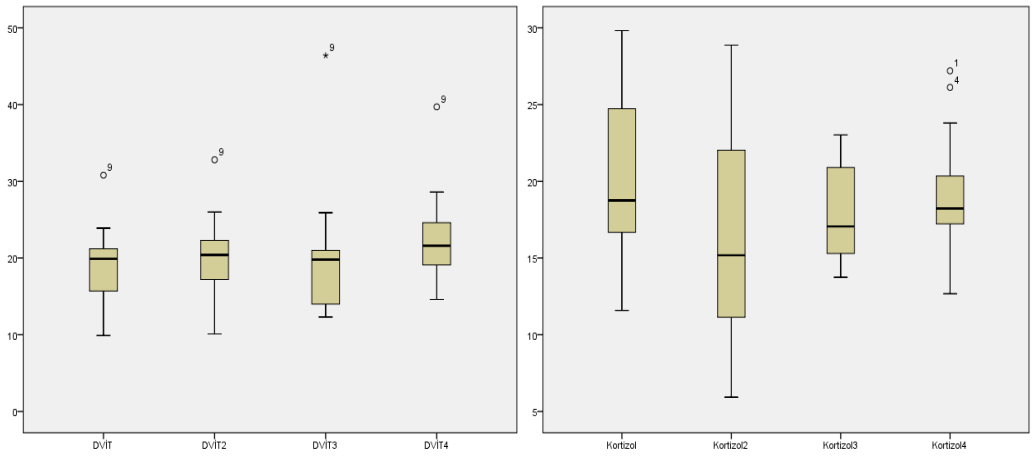


(a) (b)

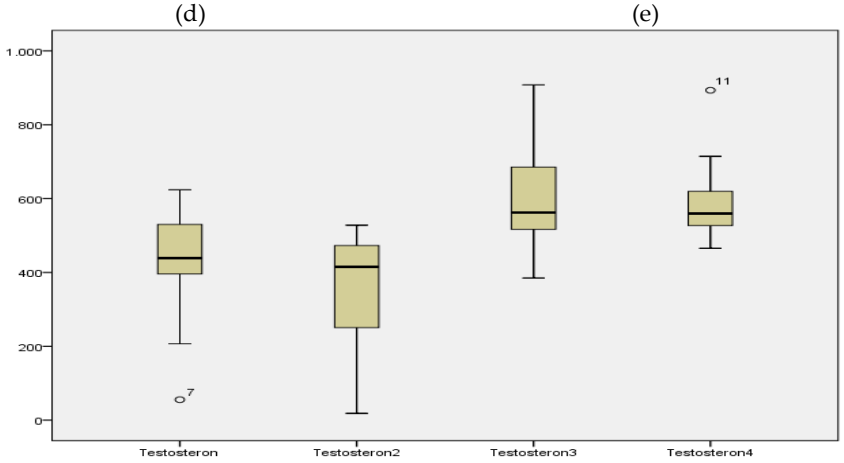


(c)

Examining Chart (a); right hand grip strength (36.00±11.93 kgf), left hand grip strength (35.08±11.02 kgf), graph (b); leg strength (86.73±33.66 kgf) and graph (c) back strength (88.06±27.10 kgf) tests; It is seen that the highest average was reached in the 4th tests.



(d) (e)



(f)

Vitamin D (graph d) reached the highest mean values (22.98±6.30 ng/mL) in the 4th test, while cortisol hormone (graph e) reached the highest mean values (20.39±5.78 µg/dL) reached in the 1st test, and the testosterone hormone (graph f) reached the highest mean values (548.20±207.00 µg/dL) in the 3rd test. When the results given in the table are examined considering the normal reference ranges, it is seen that the cortisol levels of the participants are high, and the vitamin D and testosterone levels are low.

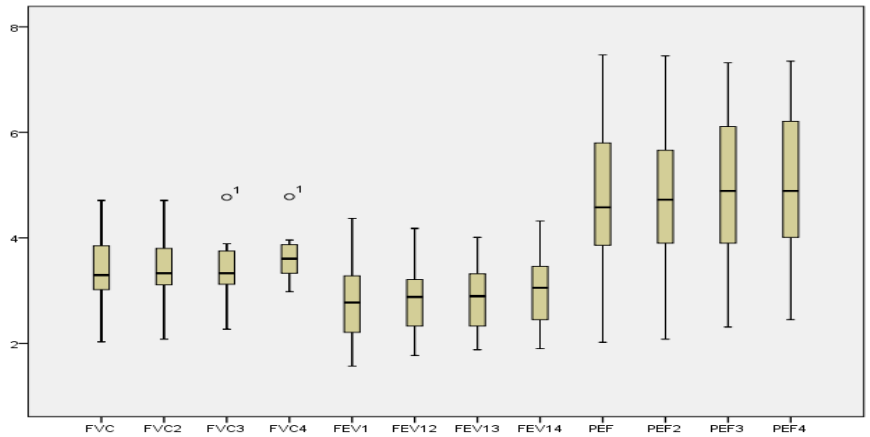
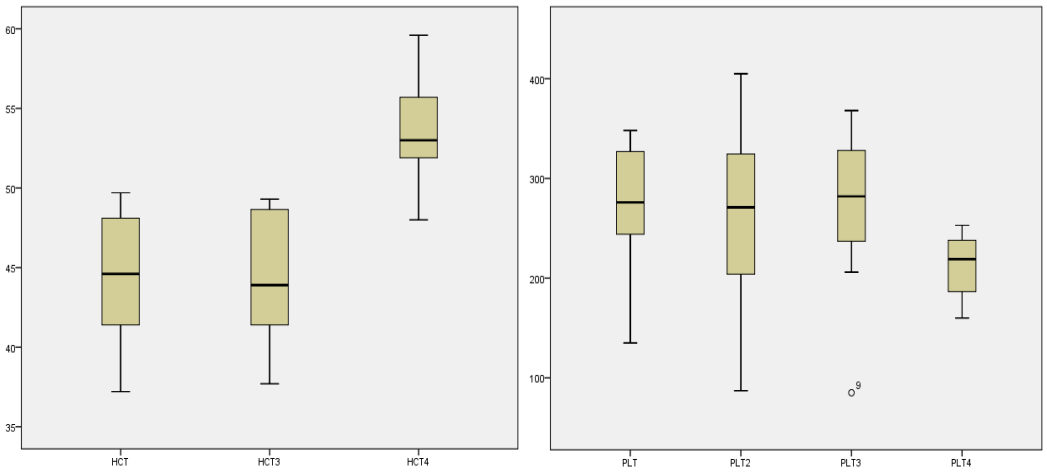
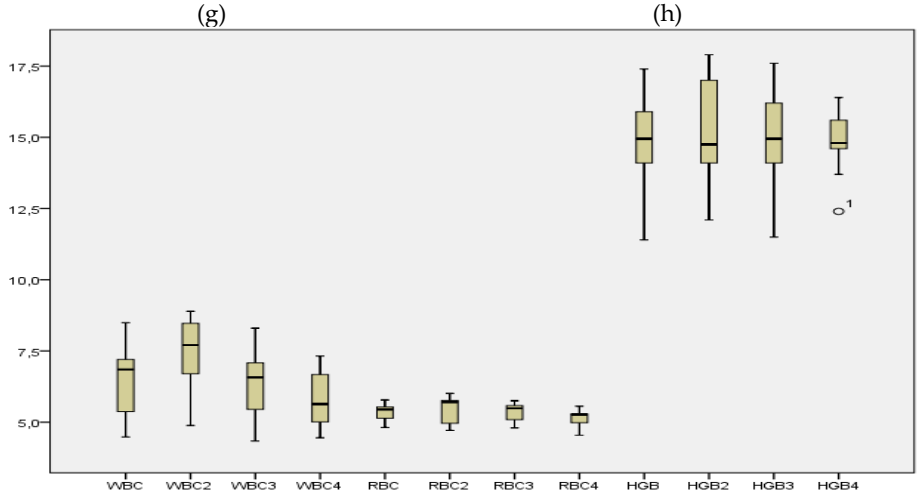


Chart 3. Respiratory Functions (FVC: forced vital capacity, FEV1: volume of air exhaled in 1 second of forced expiration, PEF: peak expiratory flow rate)

When graph (3) is examined, the highest mean in pulmonary function tests such as FVC (3.58±0.48 L), FEV1 (3.01±0.66 L), PEF (4.93±1.51 L/s) It was determined that it was reached in the 4th test.



(g) (h)



(1)

Graph (g); Hematocrit (HCT) (53.80±3.36%) levels reached the highest mean value in the 4th test, graph (h); Platelet (PLT) (264.07±97.26 cells/mL) levels reached the highest mean value in the 3rd test, graph (I); leukocyte (WBC) (7.27±1.39 x10^), erythrocyte (RBC) (5.48±0.46 x10…) and hemoglobin (HGB) (15.55±1.89 g/L) levels It was determined that high mean values were reached in the second test. It is also seen that the results are within the normal reference ranges.

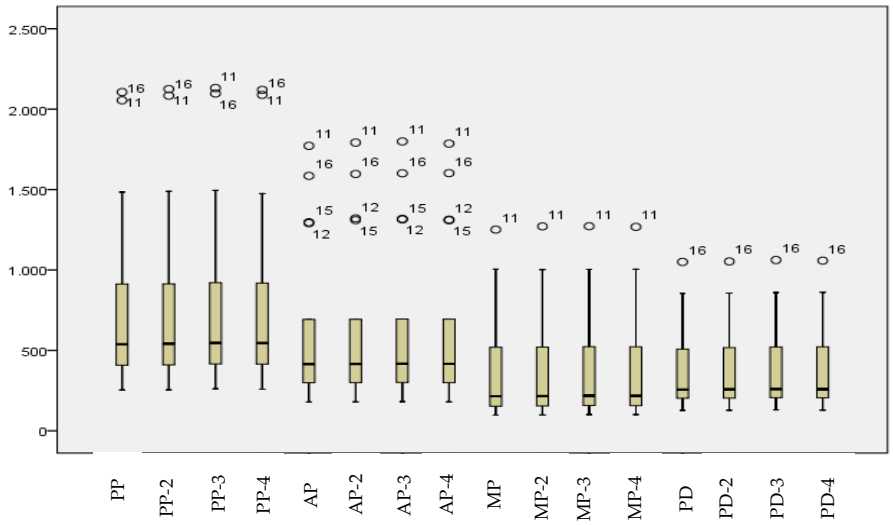


Chart 4. Anaerobic Power Parameters (PP: peak power, AP: average power, MP: minimum power, PD: power drop)

When the chart (4) is examined, PP (820.75±614.59 W), AP (655.70±523.48 W), MP (439.59±371.77 W) and PD (377.20±260, It was determined that the highest values at 35 W) levels were reached in the third test.

Table 1. Inter-test comparison at vertical jump levels

Vertical jump test		*MD*	±Ss	p
1. test	2. test	-1,933*	,250	**,000**
	3. test	-5,838*	1,076	**,001**
	4. test	-6,134*	,927	**,000**
2. test	1. test	1,933*	,250	**,000**
	3. test	-3,904*	,922	**,005**
	4. test	-4,200*	,769	**,001**
3. test	1. test	5,838*	1,076	**,001**
	2. test	3,904*	,922	**,005**
	4. test	-,296	,488	1,000
4. test	1. test	6,134*	,927	**,000**
	2. test	4,200*	,769	**,001**
	3. test	,296	,488	1,000

When Table (1) was examined, it was determined that there was a significant difference between all tests at the level of vertical jump ($p<0.012$).

Table 2. Inter-test comparison of hand grip strength levels

Right hand		*MD*	±Ss	p	Left hand		*MD*	±Ss	p
1. test	2. test	-,011*	,002	**,001**	1. test	2. test	-,016*	,003	**,000**

	3. test	-,032*	,006	**,001**		3. test	-,029*	,005	**,000**
	4. test	-,053*	,007	**,000**		4. test	-,045*	,006	**,000**
2. test	1. test	,011*	,002	**,001**	2. test	1. test	,016*	,003	**,000**
	3. test	-,021*	,005	**,006**		3. test	-,013	,004	,054
	4. test	-,042*	,006	**,000**		4. test	-,028*	,005	**,001**
3. test	1. test	,032*	,006	**,001**	3. test	1. test	,029*	,005	**,000**
	2. test	,021*	,005	**,006**		2. test	,013	,004	,054
	4. test	-,021*	,003	**,000**		4. test	-,015*	,004	**,008**
4. test	1. test	,053*	,007	**,000**	4. test	1. test	,045*	,006	**,000**
	2. test	,042*	,006	**,000**		2. test	,028*	,005	**,001**
	3. test	,021*	,003	**,000**		3. test	,015*	,004	**,008**

When Table (2) was examined, it was determined that there was a significant difference between all tests in the level of right and left hand grip strengths (p<0.012).

Table 3. Inter-test comparison of leg and back strength levels

Leg strength		***MD***	**±Ss**	**p**	**Back strength**		***MD***	**±Ss**	**p**
1. test	2. test	-,056*	,016	,020	1. test	2. test	-,019	,011	,624
	3. test	-,065*	,019	,021		3. test	-,040*	,012	,028
	4. test	-,091*	,019	**,002**		4. test	-,055*	,016	,029
2. test	1. test	,056*	,016	,020	2. test	1. test	,019	,011	,624
	3. test	-,009	,008	1,000		3. test	-,022	,009	,148
	4. test	-,034	,012	,090		4. test	-,036	,014	,115
3. test	1. test	,065*	,019	,021	3. test	1. test	,040*	,012	,028
	2. test	,009	,008	1,000		2. test	,022	,009	,148
	4. test	-,025	,011	,186		4. test	-,014	,007	,313
4. test	1. test	,091*	,019	**,002**	4. test	1. test	,055*	,016	,029
	2. test	,034	,012	,090		2. test	,036	,014	,115
	3. test	,025	,011	,186		3. test	,014	,007	,313

When Table (3) was examined, it was determined that the difference between the first and last tests of leg strength was significant (p<0.012).

Table 4. Inter-test comparison of testosterone and cortisol levels

Testosterone		***MD***	**±Ss**	**p**	**Cortisol**		***MD***	**±Ss**	**p**
1. test	2. test	78,067	33,739	,246	1. test	2. test	4,254*	1,157	,019
	3. test	-163,332	51,614	,054		3. test	2,340	2,040	1,00
	4. test	-161,814*	45,053	,025		4. test	1,119	,838	1,00

2. test	1. test	-78,067	33,739	,246		1. test	-4,254*	1,157	,019
	3. test	-241,398*	51,413	**,004**	2. test	3. test	-1,914	2,151	1,00
	4. test	-239,881*	49,883	**,003**		4. test	-3,135*	,938	,035
3. test	1. test	163,332	51,614	,054		1. test	-2,340	2,040	1,00
	2. test	241,398*	51,413	**,004**	3. test	2. test	1,914	2,151	1,00
	4. test	1,518	13,224	1,000		4. test	-1,221	1,491	1,00
4. test	1. test	161,814*	45,053	,025		1. test	-1,119	,838	1,00
	2. test	239,881*	49,883	**,003**	4. test	2. test	3,135*	,938	,035
	3. test	-1,518	13,224	1,000		3. test	1,221	1,491	1,00

When Table (4) was examined, it was determined that the difference between the 2nd, 3rd and 4th tests in testosterone hormone levels was significant (p<0.012).

Table 5. Inter-test comparison of vitamin D levels

Vitamin D		***MD***	**±Ss**	**p**
1. test	2. test	-1,077*	,232	**,003**
	3. test	-1,458	1,756	1,000
	4. test	-4,015*	,846	**,003**
2. test	1. test	1,077*	,232	**,003**
	3. test	-,382	1,732	1,000
	4. test	-2,938*	,796	,018
3. test	1. test	1,458	1,756	1,000
	2. test	,382	1,732	1,000
	4. test	-2,557	1,154	,281
4. test	1. test	4,015*	,846	**,003**
	2. test	2,938*	,796	,018
	3. test	2,557	1,154	,281

When Table (5) was examined, it was determined that the difference between the 1st, 2nd and 4th tests in vitamin D level was significant (p<0.012).

Table 6. Inter-Assay Comparison of Some Hemogram Parameters

WBC		***MD***	**±Ss**	**p**	**RBC**		***MD***	**±Ss**	**p**
1. test	2. test	-,940	,457	,418	1. test	2. test	-,117	,111	1,00
	3. test	,122	,040	,080		3. test	-,026	,028	1,00
	4. test	,783	,329	,247		4. test	,223	,144	,916
2. test	1. test	,940	,457	,418	2. test	1. test	,117	,111	1,00
	3. test	1,062	,460	,277		3. test	,091	,116	1,00

	4. test	1,723	,566	,084		4. test	,340	,164	,388
3. test	1. test	-,122	,040	,080	3. test	1. test	,026	,028	1,00
	2. test	-1,062	,460	,277		2. test	-,091	,116	1,00
	4. test	,661	,325	,435		4. test	,249	,146	,710
4. test	1. test	-,783	,329	,247	4. test	1. test	-,223	,144	,916
	2. test	-1,723	,566	,084		2. test	-,340	,164	,388
	3. test	-,661	,325	,435		3. test	-,249	,146	,710

Table 7. Inter-Assay Comparison of Some Hemogram Parameters

HGB		***MD***	**±Ss**	**p**	**HCT**		***MD***	**±Ss**	**p**
1. test	2. test	-,382	,320	1,000	1. test	2. test	-1,236	,986	1,00
	3. test	-,100	,049	,400		3. test	-,209	,223	1,00
	4. test	,218	,349	1,000		4. test	-8,873*	1,673	**,002**
2. test	1. test	,382	,320	1,000	2. test	1. test	1,236	,986	1,00
	3. test	,282	,316	1,000		3. test	1,027	,982	1,00
	4. test	,600	,396	,966		4. test	-7,636*	1,620	**,005**
3. test	1. test	,100	,049	,400	3. test	1. test	,209	,223	1,00
	2. test	-,282	,316	1,000		2. test	-1,027	,982	1,00
	4. test	,318	,360	1,000		4. test	-8,664*	1,619	**,002**
4 test	1. test	-,218	,349	1,000	4. test	1. test	8,873*	1,673	**,002**
	2. test	-,600	,396	,966		2. test	7,636*	1,620	**,005**
	3. test	-,318	,360	1,000		3. test	8,664*	1,619	**,002**

Table 8. Inter-Assay Comparison of Some Hemogram Parameters

PLT		***MD***	**±Ss**	**p**
1. test	2. test	9,545	34,112	1,000
	3. test	1,273	6,509	1,000
	4. test	61,636*	16,327	,022
2. test	1. test	-9,545	34,112	1,000
	3. test	-8,273	38,101	1,000
	4. test	52,091	26,870	,488

	FVC	*MD*	±Ss	p		FEV1	*MD*	±Ss	p		PEF	*MD*	±Ss	p
1. test	2. test	-,04	,07	1,00	1. test	2. test	-,05	,05	1,00	1. test	2. test	-,00	,08	1,00
	3. test	-,03	,11	1,00		3. test	-,08	,05	,99		3. test	-,10	,11	1,00
	4. test	-,23	,13	,58		4. test	-,23*	,07	,03		4. test	-,21	,11	,54
2. test	1. test	,04	,07	1,00	2. test	1. test	,05	,05	1,00	2. test	1. test	,00	,08	1,00
	3. test	,01	,05	1,00		3. test	-,03	,03	1,00		3. test	-,10	,05	,53
	4. test	-,18	,08	,23		4. test	-,17*	,03	**,001**		4. test	-,20*	,06	,03
3. test	1. test	,03	,11	1,00	3. test	1. test	,08	,05	,99	3. test	1. test	,10	,11	1,00
	2. test	-,01	,05	1,00		2. test	,03	,03	1,00		2. test	,10	,05	,53
	4. test	-,20*	,05	**,009**		4. test	-,14*	,03	**,005**		4. test	-,10*	,02	,02
4. test	1. test	,23	,13	,58	4. test	1. test	,23*	,07	,03	4. test	1. test	,21	,11	,54
	2. test	,18	,08	,23		2. test	,17*	,03	**,001**		2. test	,20*	,06	,03
	3. test	,20*	,05	**,009**		3. test	,14*	,03	**,005**		3. test	,10*	,02	,02

3. test	1. test	-1,273	6,509	1,000
	2. test	8,273	38,101	1,000
	4. test	60,364	20,740	,093
4. test	1. test	-61,636*	16,327	,022
	2. test	-52,091	26,870	,488
	3. test	-60,364	20,740	,093

When the table (6,7,8) was examined, it was determined that there was a significant difference between the 4th test to determine the HCT level and the 1st, 2nd and 3rd tests ($p<0.012$).

Table 9. Inter-test comparison in respiratory functions

When Table (9) was examined, it was determined that the difference between the 3rd and 4th tests was significant in the FVC value, and there was a significant difference between the 4th test and the 2nd and 3rd tests in the FEV1 value ($p<0.012$).

Table 10. Inter-test comparison of anaerobic power outputs

	MP	*MD*	±Ss	p		PD	*MD*	±Ss	p
	2. test	-5,712	2,031	,075	1. test	2. test	-5,100	2,084	,158

1. test	3. test	-12,27*	2,382	**,001**		3. test	-6,876*	2,159	,035
	4. test	-8,676*	2,120	**,005**		4. test	-4,550	1,632	,079
2. test	1. test	5,712	2,031	,075		1. test	5,100	2,084	,158
	3. test	-6,565*	,583	**,000**	2. test	3. test	-1,776*	,477	**,011**
	4. test	-2,965	1,213	,159		4. test	,550	,876	1,00
3. test	1. test	12,276*	2,382	**,001**		1. test	6,876*	2,159	,035
	2. test	6,565*	,583	**,000**	3. test	2. test	1,776*	,477	**,011**
	4. test	3,600	1,316	,088		4. test	2,326	,822	,072
4. test	1. test	8,676*	2,120	**,005**		1. test	4,550	1,632	,079
	2. test	2,965	1,213	,159	4. test	2. test	-,550	,876	1,00
	3. test	-3,600	1,316	,088		3. test	-2,326	,822	,072

Tablo 11. Inter-test comparison of anaerobic power outputs

MP		***MD***	**±Ss**	**p**	**PD**		***MD***	**±Ss**	**p**
1. test	2. test	-1,724	1,176	,973		2. test	-1,781*	,482	**,012**
	3. test	-3,929*	1,135	,019	1. test	3. test	-4,430*	,762	**,000**
	4. test	-3,118*	,957	,030		4. test	-3,550*	,779	**,002**
2. test	1. test	1,724	1,176	,973		1. test	1,781*	,482	**,012**
	3. test	-2,206*	,166	**,000**	2. test	3. test	-2,649*	,433	**,000**
	4. test	-1,394*	,368	**,010**		4. test	-1,769*	,380	**,002**
3. test	1. test	3,929*	1,135	,019		1. test	4,430*	,762	**,000**
	2. test	2,206*	,166	**,000**	3. test	2. test	2,649*	,433	**,000**
	4. test	,812	,318	,127		4. test	,880*	,249	,016
4. test	1. test	3,118*	,957	,030		1. test	3,550*	,779	**,002**
	2. test	1,394*	,368	**,010**	4. test	2. test	1,769*	,380	**,002**
	3. test	-,812	,318	,127		3. test	-,880*	,249	,016

When the table (10,11) is examined, it is seen that there is a significant difference between the tests in the PP and PD outputs. Further, there is a significant difference between the 2nd and 3rd tests in the AP output and there is a significant difference between the 2nd test and the 3rd and 4th tests in the MP output ($p<0.012$).

4. Discussion

The researches related to the parameters examined in the study were discussed, were reported and interpreted.

Doğan and Özkan (2021), in their study on male tennis players aged 12-14, found the back strength to be 65.5±17.24, the leg strength to be 66.65±19.1, the right hand grip strength to be 29.73±9.19, and the left hand grip strength to be 25.07±7.37 [26]. In an 8-

week study of football players aged 12-14, back strength was reported as 62.34±10.09 in the pre-test, 73.2±6.84 in the post-test, and leg strength as 74.94±11.33 in the pre-test and 83.10±11.98 in the post-test. At the end of the same study, the FEV1 was found to be 3.07±0.28 and the FVC to be 3.11±0.47 [27]. The reason for the better results in our study (graph 3,4,5) is thought to be due to the wider age range and more intense hormonal development.

Opal et al., (2018) found that there was 42.3% of vitamin D deficiency and 27.2% of insufficiency in children in Erzincan province. It has been reported that only 30.5% of children are above the accepted reference values for vitamin D. In a seasonal review in the same study, it was observed that both boys and girls (all age groups) had a decrease in vitamin D levels in winter and spring [28].

In a study conducted in Samsun, during the winter months; serum 25-OH D level of 13,395 individuals was found to be 14.71 ± 10.21 ng/mL; however, in summer months; serum 25-OH D level of a total of 10,378 individuals was determined as 19.13 ± 11.09 ng/mL. While a higher level in the summer months is likely, it is noteworthy that the mean is at levels of severe deficiency (<20 ng/ml) in both seasons [29].

Öğüş et al., (2015) found that the mean vitamin D levels of patients were 22.80±13.27 ng/mL between January and December. In 47.00% of patients (50% in women, 38% in men) vitamin D levels were below the deficiency limit (<20 ng/mL), 28.00% were within the deficiency limits (20-30 ng/mL), 25% of them were at the optimal level (>30 ng/mL) [30].

Seo et al., (2019) conducted a study on 47 male adolescent taekwondo players (age 16.7±0.84 years, height 175.2±5.97cm, body mass 66.2±10.46kg, and training experience 53.4±10.60months). They trained for at least 3 hours a day, 5 days a week. At the end of the study, approximately 75% of the participants were found to have vitamin D deficiency [31].

In some studies on football and gymnastics athletes, the prevalence of vitamin D deficiency or insufficiency has been reported to range from 59% to 94% [32,33,34].

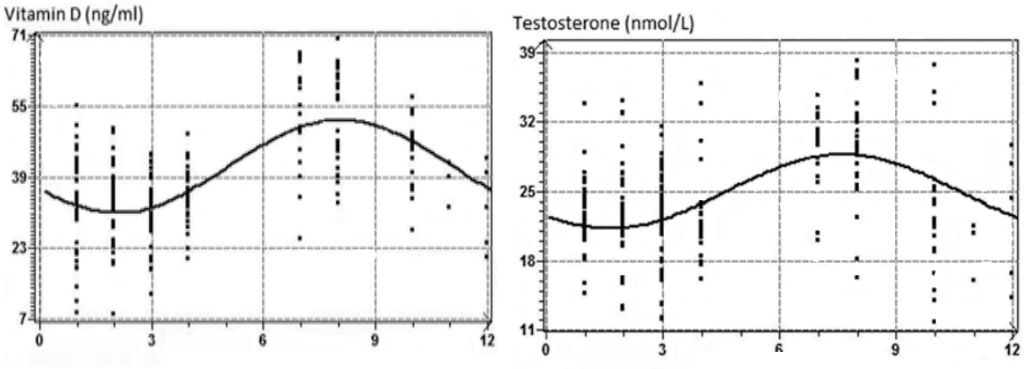
Abate and Salini (2022) examined the seasonal changes in vitamin D, cortisol and testosterone release in the study they conducted on Italian B series football players (a total of 50 football players, 38 Caucasian and 12 African origin) (table 12).

Table 12. Some hormones in Caucasian and African football players

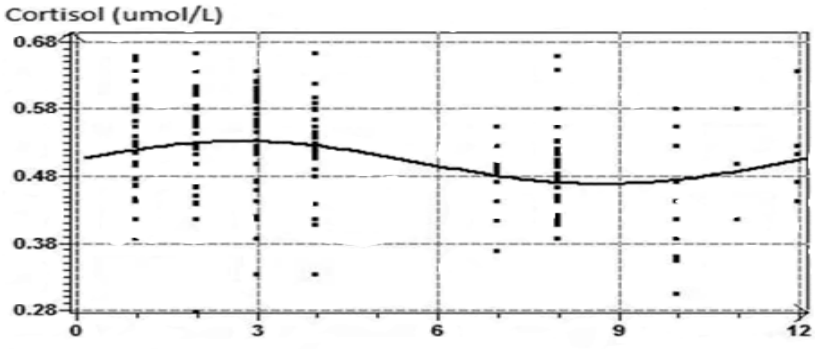
	Africa		Caucasia	
	August	February	August	February
Testosterone (nmol/L)	11,5±2,4	10,3±1,6	9,1±2,6	7,7±2,3
Cortisol (μg/dL)	8,2±1,6	9,6±1,7	8,6±2,3	10,9±4,4
Vitamin D (ng/mL)	33,4±9,7	27,4±9,4	39,4±11,1	31,8±9,7

All athletes participating in the study had high testosterone levels in the summer months. The reason for this has been attributed to the temperature of the air, unlimited lifestyle and sexual excitement. Cortisol was found at high levels in the winter months, and the reason for this was shown as weather conditions, competition and training intensities. Vitamin D, on the other hand, was found at high levels in the summer months and was attributed to its better synthesis by the skin when exposed to ultraviolet B radiation. It has been reported that the results of the study (table 12) are similar to other results in the literature [35].

Lombardi et al., (2017) examined seasonal changes in vitamin D, testosterone and cortisol secretion in their study on 167 professional football players in the Italian league (graph i,j,k).



(l) (J)



(k)

As a result of the study, it was determined that vitamin D and testosterone levels increased in summer months, while cortisol levels were higher in winter months (graph 14,15,16) [36]

Michalczyk et al. (2020) examined the effects of winter sun and summer sun on vitamin D in their study during the season (graph 5).

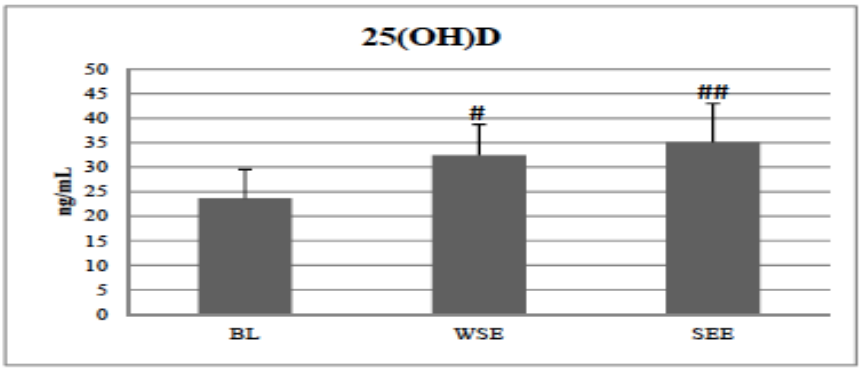


Chart 5. Vitamin D (BL: normal weather conditions, WSE: after winter sunlight, SEE: after summer sunlight)

As a result of the study, it was determined that the winter sun increased the vitamin D level more than the normal, and the summer sun increased the vitamin D level more than the normal and winter sun (chart 5).

5. Conclusions

In male skiers between the ages of 10-18, who were found to be endomorphic; vertical jump, right-left hand grip strength, leg and back strength, vitamin D, FVC, FEV1, PEF and HCT parameters reached the highest level in November (autumn/4th test).

The highest level in P, AP, MP, PD, PLT and testosterone parameters in June (summer/3rd test), the highest level in WBC, RBC, HGB parameters in April (spring/2nd test), and the highest level in cortisol hormone were reached in January (winter/1st test). When the results were analyzed considering the normal reference ranges, it was observed while cortisol levels were high, vitamin D and testosterone levels were low. It was determined that the results were within the normal reference ranges in selected hemogram parameters.

In the inter-test comparison results, significant differences were determined in vertical jump, right and left hand grip strength, leg strength, testosterone, vitamin D, HCT, FVC, FEV1 and anaerobic power parameters.

It was thought that the results of the study were mostly similar to the results of the literature. Although it was surprising that Vitamin D was higher in November, the effect was thought to persist in the summer months. Considering the gender, age, altitude, training environment and training level of the participants, probable outcomes were result in.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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References

1. Floyd, M.; Ayyar, D.R.; Barwick, D.D.; Hudgson, P.; Weightman, D. Myopathy in chronic renal failure. *Q J Med* **1974**, 43, 509-524.
2. Ross, A.C.; Manson, J.E.; Abrams, S.A.; Aloia, J.F.; Brannon, P.M.; Clinton, S.K.; Durazo-Arvizu, R.A.; Gallagher, J.C.; Gallo, R.L.; Jones, G.; Kovacs, C.S.; Mayne, S.T.; Rosen, C.J.; Shapses, S.A. The 2011 report on dietary reference intakes for calcium and vitamin D from the Institute of Medicine: what clinicians need to know. *J Clin Endocrinol Metab* **2011**, 96, 53-58.
3. Girgis, C.M.; Clifton-Bligh, R.J.; Hamrick, M.W.; Holick, M.F.; Gunton, J.E. The roles of vitamin d in skeletal muscle: form, function, and metabolism. *Endocr Rev* **2013**, 34, 33-83.
4. Bouillon, R.; Carmeliet, G.; Verlinden, L.; van Etten, E.; Verstuyf, A.; Luderer, H.F.; Lieben, L.; Mathieu, C.; Demay, M. Vitamin d and human health: lessons from vitamin d receptor null mice. *Endocr Rev* **2008**, 29, 726-776.
5. Johnson, J.A.; Grande, J.P.; Roche, P.C.; Kumar, R. Ontogeny of the 1,25-dihydroxyvitamin d3 receptor in fetal rat bone. *J Bone Miner Res* **1996**, 11, 56-61.
6. Vingren, J.L.; Kraemer, W.J.; Ratamess, N.A.; Anderson, J.M.; Volek, J.S.; Maresh, C.M. Testosterone physiology in resistance exercise and training: the up-stream regulatory elements. *Sports Med* **2010**, 40, 1037-53.
7. MacLean, H.E.; Chiu, W.S.; Notini, A.J.; Axell, A.M.; Davey, R.A.; McManus, J.F.; Ma, C.; Plant, D.R.; Lynch, G.S.; Zajac, J.D. Impaired skeletal muscle development and function in male, but not female, genomic androgen receptor knockout mice. *FASEB J* **2008**, 22, 2676-89.
8. Rossetti, M.L.; Steiner, J.L.; Gordon, B.S. Androgen-mediated regulation of skeletal muscle protein balance. *Mol Cell Endocrinol* **2017**, 447, 35-44.
9. Pollanen, E.; Kangas, R.; Horttanainen, M.; Niskala, P.; Kaprio, J.; Butler-Browne, G.; Mouly, V.; Sipilä, S.; Kovanen, V. Intramuscular sex steroid hormones are associated with skeletal muscle strength and power in women with different hormonal status. *Aging Cell* **2015**, 14, 236-48.
10. Bhasin, S.; Travison, T.G.; Storer, T.W.; Lakshman, K.; Kaushik, M.; Mazer, N.A.; Ngyuen, A.H.; Davda, M.N.; Jara, H.; Aakil, A.; Anderson, S.; Knapp, P.E.; Hanka, S.; Mohammed, N.; Daou, P.; Renee Miciek, R.; Ulloor, J.; Zhang, A.; Brooks, B.; Orwoll, K.; Hede-Brierley, L.; Eder, R.; Elmi, A.; Bhasin, G.; Collins, L.; Singh, R.; Basaria, S. Effect of testosterone supplementation with and without a dual 5a-reductase inhibitor on fat-free mass in men with suppressed testosterone production: a randomized controlled trial. *JAMA* **2012**, 307, 931-9.

11. Borst, S.E.; Yarrow, J.F.; Conover, C.F.; Nseyo, U.; Meuleman, J.R.; Lipinska, J.A.; Braith, R.W.; Beck, D.T.; Martin, J.S.; Morrow, M.; Roessner, S.; Beggs, L.A.; McCoy, S.C.; Cannady, D.F.; Shuster, J.J. Musculoskeletal and prostate effects of combined testosterone and finasteride administration in older hypogonadal men:a randomized, controlled trial. *Am J Physiol Endocrinol Metab* **2014**, 306, E433-42.
12. Kraemer, W.J.; Ratamess, N.A.; Nindl, B.C. Recovery responses of testosterone, growth hormone, and igf-1 after resistance exercise. *J Appl Physiol* **2017**, 122, 549-58.
13. Jardi, F.; Laurent, M.R.; Dubois, V.; Kim, N.; Khalil, R.; Decallonne, B.; Vanderschueren, D.; Claessens, F. Androgen and estrogen actions on male physical activity: a story beyond muscle. *J Endocrinol* **2018**, 238, R31-52.
14. Kraemer, W.J.; Ratamess, N.A.; Hymer, W.C.; Nindl B.C.; Fragala, M.S. Growth hormone(s), testosterone, insulin-like growth factors, and cortisol: roles and integration for cellular development and growth with exercise. *Front Endocrinol* **2020**, 11, 33.
15. MacKrell, J.G.; Yaden, B.C.; Bullock, H.; Chen, K.; Shetler, P.; Bryant, H.U.; Krishnan, V. Molecular targets of androgen signaling that characterize skeletal muscle recovery and regeneration. *Nucl Recept Signal* **2015**, 13, e005.
16. Sheffield-Moore, M.; Urban, R.J. An overview of the endocrinology of skeletal muscle. *Trends Endocrinol Metab* **2004**, 15, 110-5.
17. Chan, S.; Debono, M. Replication of cortisol circadian rhythm: new advances in hydrocortisone replacement therapy. *Ther Adv Endocrinol Metab* **2010**, 1, 129-38.
18. Hsu, S.C.; DeFranco, D.B. Selectivity of cell cycle regulation of glucocorticoid receptor function. *J Biol Chem* **1995**, 270, 3359-64.
19. Lamberts, S.W.; Huizenga, A.T.; de Lange, P.; de Jong, F.H.; Koper, J.W. Clinical aspects of glucocorticoid sensitivity. *Steroids* **1996**, 61, 157-60.
20. Polman, J.A.E.; Hunter, R.G.; Speksnijder, N.; van den Oever, J.M.E.; Korobko, O.B.; McEwen, B.S.; de Kloet, E.R.; Datson, N.A. Glucocorticoids modulate the mtor pathway in the hippocampus: differential effects depending on stress history. *Endocrinology* **2012**, 153, 4317-27.
21. Munck, A.; Guyre, P.M.; Holbrook, N.J. Physiological functions of glucocorticoids in stress and their relation to pharmacological actions. *Endocr Rev* **1984**, 5, 25-44.
22. Duclos, M.; Gouarne, C.; Bonnemaison, D. Acute and chronic effects of exercise on tissue sensitivity to glucocorticoids. *J Appl Physiol* **2003**, 94, 869-75.
23. Kraemer, W.J.; Fleck, S.J.; Dziados, J.E.; Harman, E.A.; Marchitelli, L.J.; Gordon, S.E.; Mello, R.; Frykman, P.N.; Koziris, L.P.; Triplett, N.T. Changes in hormonal concentrations after different heavyresistance exercise protocols in women. *J Appl Physiol* **1993**, 75, 594-604.
24. Kraemer, W.J.; Patton, J.F.; Gordon, S.E.; Harman, E.A.; Deschenes, M.R.; Reynolds, K.; Newton, R.U.; Triplett, N.T.; Dziados, J.E. Compatibility of high-intensity strength and endurance training on hormonal and skeletal muscle adaptations. *J Appl Physiol* **1995**, 78, 976-89.
25. Gouarne, C.; Groussard, C.; Gratas-Delamarche, A.; Delamarche, P.; Duclos, M. Overnight urinary cortisol and cortisone add new insights into adaptation to training. *Med Sci Sports Exerc* **2005**, 37, 1157-67.
26. Doğan, F.; Özkan, A. 12-14 yaş tenisçilerin tenise özgü becerilerinin incelenmesi. *Spor Bilimleri Araştırmaları Dergisi* **2021**, 6, 401-420.
27. Dağdelen, S.; Kumartaşlı, M. 12-14 yaş arası futbolcularda 8 haftalık antrenman programının fizyolojik ve biyomotorik özelliklere etkisi. *Akdeniz Spor Bilimleri Dergisi* **2021**, 4, 73-88.
28. Topal, İ.; Mertoğlu, C.; Arslan, Y.K.; Gümüş, A.; Sürücü Kara, İ.; Peker, N. Erzincan bölgesindeki çocukların d vitamini seviyelerinin yaş, cinsiyet ve mevsimlere göre değerlendirilmesi. *Fırat Med J* **2018**, 23, 168-172.
29. Çubukçu, M.; Acı, R.; Müderrisoğlu, S. Samsun ilinde d vitamini düzeylerinin yaş, cinsiyet ve mevsimsel özelliklere göre değerlendirilmesi. *Ankara Med J* **2019**, 4, 769-75.
30. Öğüş, E.; Sürer, H.; Kılınç, A.Ş.; Fidancı, V.; Yılmaz, G.; Dindar, N.; Karakaş, A. D vitamini düzeylerinin aylara, cinsiyete ve yaşa göre değerlendirilmesi. *Ankara Med J* **2015**, 15, 1-5.
31. Seo, M.W.; Song, J.K.; Jung, H.C.; Kim, S.W.; Kim, J.H.; Lee, J.M. The associations of vitamin d status with athletic performance and blood-borne markers in adolescent athletes: a cross-sectional study. *Int J Environ Res Public Health* **2019**, 16, 3422.
32. Owens, D.J.; Allison, R.; Close, G.L. Vitamin d and the athlete: current perspectives and new challenges. *Sports Med* **2018**, 48, 3-16.
33. Lovell, G. Vitamin d status of females in an elite gymnastics program. *Clin J Sport Med* **2008**, 18, 159-161.
34. Willis, K.S.; Peterson, J.; Larson-Meyer, D.E. Should we be concerned about the vitamin d status of athletes? *Int J Sport Nutr Exerc Metab* **2008**, 18, 204-224.
35. Abate, M.; Salini, V. Oxidative stress, testosterone, cortisol and vitamin d: differences in professional soccer players of african and caucasian origin. *Med Princ Pract* **2022**, 31, 352-358.
36. Lombardi, G.; Vitale, J.A.; Logoluso, S.; Logoluso, G.; Cocco, N.; Cocco, G.; Cocco, A.; Banfi, G. Circannual rhythm of plasmatic vitamin D levels and the association with markers of psychophysical stress in a cohort of Italian professional soccer players. *Chronobiol Int* **2017**, 34, 471-479.

37. Michalczyk, M.M.; Goła´s, A.; Maszczyk, A.; Kaczka, P.; Zajac, A. Influence of sunlight and oral d3 supplementation on serum 25(oh)d concentration and exercise performance in elite soccer players. *Nutrients* **2020**, 12, 1311.
38. Sirri, W.E. *Gross composition of the body, advance in biological and medical phiyics*. 4rd ed.; Academic Press: New York: USA, 1956.
39. Durnin, J.V.; Womersley, J. Body fat assesed from total body density and its estimation from skinfold tickness: measurements on 481 men and women aged from 16 to 72 years. *Br J Nutr* **1974**, 32, 77-97.
40. Sheldon, W.H.; Dupertuis, C.M.; Mc Dermott, E. *Atlas of Men*, 3rd ed.; Harper and Brothers: New York: USA, 1954.