Comparison of individuals doing sports in indoor and outdoor areas and sedentary individuals in terms of vitamin D, body fat content, and obesity values

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Abstract. – OBJECTIVE: The aim of this study was to compare the body fat content, vitamin D, serum lipid levels, and obesity values of individuals doing sports indoors and outdoors and sedentary individuals.

PATIENTS AND METHODS: The research was conducted as a case-control study. The case group consisted of 30 participants between the ages of 18-30 who did outdoor sports, the first control group consisted of 30 participants doing sports indoors, and the second control group consisted of 30 sedentary participants. Voluntary consent was obtained from the research group, which consisted of 90 participants in total. As inclusion criteria for the study, they were asked to be healthy, not have chronic diseases, to be doing sports outdoors or indoors, and as the control group, individuals who did not do sports. Participants were asked to complete a questionnaire about their socio-demographic characteristics, vitamin D level, and factors affecting body fat ratio.

RESULTS: 57.8% of the participants (52 participants) were male, and 42.2% (38 female) were female. The mean age of the study group was 22.26 ± 3.86. The body mass index (BMI) was 22.91 ± 4.06. Waist/hip ratio 0.76 ± 0.06. Serum values averages were as follows: calcium 11.74 ± 0.06, cholesterol 156.23 ± 32.34, high-density lipoprotein (HDL) 48.68 ± 12.45, magnesium 1.83 ± 0.14, phosphorus 3.52 ± 0.78, triglyceride (TGL) 120.76 ± 56.25, vit 25-OH 24.71 ± 1.35, parathormone (PTH) 48.24 ± 2.95. BMI was 21.03 ± 2.94 for those doing outdoor sports, 23.51 ± 3.31 for those who play sports in the indoor area, and 24.06 ± 5.22 for those who cannot do any sport, the difference was statistically significant ($p = 0.001$). Vitamin 25-OH was found to be 30.75 ± 11.54 in the outdoor sports, 21.59 ± 7.04 in the indoor sports 22.77 ± 3.16 in the non-sports groups and the difference was statistically significant ($p < 0.004$). Total cholesterol levels were 150.63 ± 6.09 for those doing outdoor sports, 150.92 ± 4.56 for those doing indoor sports, and 169.61 ± 6.57 for non-athletes. Total cholesterol was significantly lower in those who do sports indoors and outdoors compared to those who do not ($p < 0.02$ and $p < 0.03$, respectively).

CONCLUSIONS: Sport has a positive effect on body mass index and serum cholesterol levels. Outdoor sports have a more positive effect on the vit 25-OH levels and serum lipid profile than indoor sports.

Key Words:
Sports, Vitamin D, BMI, Obesity, Indoor and outdoor sports.

Introduction

Vitamin D deficiency is a common problem worldwide. Vitamin D deficiency is observed in approximately 77% of the population[1]. Common diseases are important for public health. The main causes of vitamin D deficiency are inadequate intake, limited use of sunlight, and insufficient synthesis in the skin and kidneys. Vitamin D is a fat-soluble steroidal prohormone produced in the skin as a result of exposure to sunlight. With various metabolic changes, it turns into a hormone known as calcitriol, which plays an important role in calcium and phosphorus metabolism[2]. Vitamin D deficiency has negative health consequences (diabetes, cardiovascular disease, cancers, all-cause mortality). An increase in body fat leads to low vitamin D levels, so an accurate understanding of the mechanisms that cause vitamin D de-

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ficiency is important for defining and implementing effective interventions[3].

Clinical Practice Guidelines[4] prepared by the Endocrine Society, state that body weight plays an important role in vitamin D requirement, and recommend that obese patients be given two to three times more vitamin D than normal-weight individuals to meet their body's vitamin D requirement. In a review[3] discussing the loss of adipose tissue volume with energy restriction and/or physical activity and the change in circulating 25-OH vit D levels, it was stated that low 25-OH vit D was associated with excessive adiposity, especially visceral adiposity.

Healthy lifestyle habits are recommended for the treatment of obesity-related vitamin D deficiency, and it is important to ensure the loss of visceral adiposity in this perspective. When the 25-OH vit D levels were improved, and the stores were replenished, with the vitamin D supplement given according to the weight of the individuals, the diseases related to obesity, such as insulin resistance, inflammation, hypertension, and dyslipidemia, decreased. In addition to that, the positive effect of vitamin D on athlete health and performance is very well known[5]. The increase in vitamin D levels in athletes has beneficial effects on the musculoskeletal system. Vitamin D levels below 30 nmol/L cause a decrease in muscle strength[6]. High vitamin D levels, on the other hand, increase protein synthesis, muscle strength, exercise capacity, and physical performance, while reducing stress fracture rates[1,7]. Vitamin D deficiency is more common in athletes, especially indoor sports, than other athletes[8].

With the recent increase in interest in vitamin D the majority of athletes are recommended to supplement with vitamin D. The only reason for this interest is not the diseases that develop due to vitamin D deficiency but the increasing importance of vitamin D with the discovery that its receptors are found in many tissues. Vitamin D is not only associated with oral intake, unlike other vitamins, it needs ultraviolet rays (UV-B) for its synthesis. This feature makes it unique[9]. It is known that vitamin D can positively affect mechanical recovery by alleviating the risk of exercise-related trauma and infection. There are studies[8] on the positive effect of vitamin D supplementation on strength, endurance oxygen consumption (VO_2), immune system and muscle injuries, and bone and stress fractures in athletes with vitamin D deficiency. Some researchers[10,11] have mentioned that vitamin D deficiency may be common in athletes, but its prevalence is unknown, and the predisposing factors for vitamin D deficiency are not clear. In a case-control study[12], 25-OH vit D levels were found to be lower in obese individuals compared to the other group. This suggests that there is a relationship between obesity and vitamin D. According to World Health Organization (WHO), those with a body mass index of 25 and above were defined as overweight, and those of 30 and above were defined as obese[13].

The decrease in the serum level of vitamin D due to volumetric dilution in obese individuals and the decrease in the expression level of enzymes that activate vitamin D are possible mechanisms for the lower vitamin D level in these individuals compared to normal-weight individuals[14]. The low level of vitamin D in obese individuals may also be due to the inability of these individuals to benefit from outdoor activities sufficiently and the obese individuals to wear more closed clothes[15].

The aim of this study was to compare the body fat content, vitamin D, and obesity values of individuals who do sports indoors and outdoors and sedentary individuals.

Patients and Methods

The research was conducted as a case-control study. This study was carried out at Van Yüzüncü Yıl University, School of Physical Education and Sports. Participants were selected among the students studying in this department. The case group consisted of 30 participants between the ages of 18-30 who did outdoor sports, the first control group consisted of 30 participants doing sports indoors, and the second control group consisted of 30 sedentary participants. Voluntary consent was obtained from the research group, which consisted of 90 participants in total. All individuals participating in the study were asked to fill in an informed voluntary consent form, which was signed and archived. As inclusion criteria for the study, they were asked to be healthy, not have a chronic disease, to be doing sports outdoors or indoors, and as the control group, participants who did not do sports. The exclusion criteria were determined as individuals not wanting to participate, having a disease, and not meeting the inclusion criteria.

Participants were asked to complete a questionnaire about their socio-demographic characteristics, vitamin D level, and factors affecting body fat ratio. 5 cc blood samples were taken from each participant in order to measure 25-OH vit D and lipid profile in the serum by two doctors involved in the study. Analyzes of serum samples were examined in the hospital laboratory with service procurement. Body fat content was measured with a body analyzer (Tanita BC-601). Hip and waist measurements were measured in meters and presented in cm. Ethics committee approval was obtained for this study from the Van Training and Research Hospital Clinical Researches Local Ethics Committee with the decision dated and numbered (12.04.2018/07).

Statistical Analysis

SPSS (Statistical Package for the Social Sciences) program, version 20, (IBM Corp., Armonk, NY, USA) was used to analyze the data obtained from the study. Categorical variables were compared with the Chi-square test. Normality analysis of continuous variables was evaluated with the Shapiro-Wilk test. Kruskal-Wallis test analysis was performed in three groups because it did not meet the parametric test conditions. If a difference was found, the Mann-Whitney U test was performed after Kruskal-Wallis. Bonferroni test correction was applied. Mann-Whitney U test was used in the comparison of the paired groups because it did not meet the parametric test conditions. Analysis results are given as descriptive statistics frequency, mean ± standard deviation. The level of significance was accepted as $p < 0.05$.

Results

57.8% (52 participants) of the individuals participating in the study were men and 42.2% (38 participants) were women. The mean age of the study group was 22.26 ± 3.86. When their marital status was asked, 5.6% (5 participants) were married, 93.3% (84 participants) were single, and 1.1% (1 participant) was widow. Considering their social security, one participant did not answer the question, 60.7% (54) had serum and glucocorticoid kinase (SGK), 20.2% (18 participants) had a green card, 4.5% (4 participants) had private insurance, 14.6% (13 participants) stated that they do not have any social security. 72.2% (65 participants) of the participants are nuclear families, 26.7% (24 participants) are extended, 1.1% (1 participant) are broken families. Considering the income situation 51.1% (46 participants) stated that their income is equal to their expenses, 30.0% (27 participants) stated that their income is lower than their expenses, and 18.9% (17 participants) stated that their incomes were more than their expenses. When the participants were asked "How many hours a day do you spend outdoors on average?", 3.3% (3 participants) stated that they spent 0-1 hour 31.1% (25 participants) 2-4 hours 68.9% (62 participants) spent more than 5 hours. When asked about the use of sunscreen, 63.3% (57 participants) stated that they did not use it, 31.1% (28 participants) stated that they used it in the summer season, and 5.6% (5 participants) used it constantly. Sun exposure until 11 am is 70% (63 participants), and after 12 pm, sun exposure is 30% (27 participants). When asked about the areas of the body exposed to the sun (such as the face, hands, arms, and legs) when they go out to the open area, 16.7% (15 participants) responded to only one area, 22.2% (20 people) to two body areas, 61%, 1 (55 people) stated that three or more body areas were exposed to the sun.

According to the status of using vitamin D supplements, 23.3% of the participants stated that they took vitamin D supplements constantly, 22.2% sometimes. 4.4% of the participants stated that they use multivitamin supplements constantly and 10.0% stated that they sometimes take multivitamin supplements. 10.0% reported that they sometimes take multivitamin supplements. Those who constantly use nutritional supplements are 7.8%, and those who use them sometimes are 3.3%. When asked about fish consumption, 56.7% (51 participants) say they consume 1-2 per month, 12.2% (11 participants) 1-2 per week, and 31.1% (28 participants) do not consume fish at all. Those who consume walnut almonds every day are 13.3% (12 participants), those who consume 1-2 per week 41.1% (37 participants), and those who consume 1-2 per month are 41.1% (37 participants). Those who consume milk and dairy products every day are 44.9% (40 participants), those who consume 1-2 per week are 34.8% (31 participants), those who consume 1-2 per month are 16.9% (15 participants), 3.4% (3 participants) do not consume any milk and dairy products. 68.9% (62 participants) of the participants in the study have 3 main meals. Bread consumption was, on average, 4.61 ± 3.69 slices. Consumption of other carbohydrates (rice, pasta, etc.) is approx 7.74 ± 5.45 spoons. While 25.6% (23 participants) of the participants consume dessert almost every day, 52.2% (47 participants) consume 1-2 desserts a week, 20.0% (18 participants) consume 1-2 desserts a month, 2% of them (2 participants) do not consume at all. According to the answers given to protein consumption, 34.5% almost every day, 60.0% 1-2 days a week, 4.4% (4 participants) 1-2 times a month, and 1.1% (1 participant) do not take any protein conclusion has been reached.

Water consumption was approx 10.19 ± 5.65 glasses. 30.0% (27 participants of the participants use cigarettes constantly or occasionally, and 13.3% (12 participants) use alcohol. No addictive substance use has been reported. The mean body mass index (BMI) was 22.91 ± 4.06. The mean waist/hip ratio was 0.76 ± 0.06. The averages of serum values were as follows; calcium 11.74 ± 0.06, arm 156.23 ± 32.34, high-density lipoprotein (HDL) 48.68 ± 12.45, magnesium 1.83 ± 0.14, phosphorus 3.52 ± 0.78, triglyceride (TGL) 120.76 ± 56.25 vit 25-OH 24.71 ± 1.35, parathormone (PTH) 48.24 ± 2.95. The use of sunscreen cream was significantly higher in women than in men.

The use of sunscreen cream, multivitamins, vitamin D, and nutritional supplements by gender is shown in Table I. There was no significant variation between men and women in terms of fish, walnuts, almonds, hazelnuts, milk and dairy products, as well as protein consumption. There was no statistically significant difference between men and women in terms of addictive substance use (cigarette and alcohol). The mean body mass index was 22.25 ± 3.69 in women and 23.52 ± 4.43 in men, and the difference was not statistically significant. The mean TGL in women was 99.22 ± 36.76 in men was 133.89 ± 63.88, serum TGL levels were significantly higher in men ($p < 0.002$). The mean HDL in women was 57.08 ± 13.10, in men was 43.19 ± 8.28 in men, and HDL levels were significantly higher in women ($p < 0.001$). There is no difference between men and women in terms of other serum values Table I.

When the sociodemographic characteristics of the groups doing sports outdoors, doing sports indoors, and not doing sports were compared, no significant difference was found between the groups. The comparison of the study groups in terms of using protective cream and taking vitamin D supplements was given in Table II, respectively. The use of protective cream was significantly lower in those who do outdoor and indoor sports than those who never do ($p < 0.01$ and $p < 0.01$, respectively). There was no difference between those who do sports outdoors and those who do sports indoors in terms of using protective cream (Table II).

25-OH vit D was found to be 28.98 ± 2.79 in those who regularly use vitamin D supplements, 26.77 ± 3.34 in those who use it occasionally, and 22.64 ± 1.75 in those who never use it. The differ-

Table I. Comparison of the usage of supplements and barrier creams depending on gender.

Factors	Gender	Yes		No		Occasionally*		*p*
		Quantity	%	Quantity	%	Quantity	%	
*Suntan cream	Female	5	13.2	17	44.7	16	42.1	**0.002**
	Male	0	0	40	76.9	12	23.1	
Multivitamin	Female	2	5.3	31	81.6	5	13.2	0.67
	Male	2	3.8	46	88.5	4	7.7	
Vitamin D	Female	7	18.4	17	44.7	14	36.9	**0.01**
	Male	14	26.9	32	61.6	6	11.5	
Food Supplement	Female	2	5.3	35	92.1	1	2.6	0.72
	Male	5	9.6	45	86.6	2	3.8	

*Barrier sun cream only mentioned to be used in the summer period.

Table II. Comparison of the groups in terms of sunscreen cream use.

Barrier cream usage	Always		Summer time		Never		*p*
	Quantity	%	Quantity	%	Quantity	%	
Outdoor sports	0	0	8	26.7	22	73.3	0.007
Indoor sports	2	6.7	5	16.7	23	76.7	
No sports	3	10.0	15	50.0	12	40.0	

Table III. Comparison of the groups in terms of vitamin D use.

Vit D usage	Yes		No		Occasionally		*p*
	Quantity	%	Quantity	%	Quantity	%	
Outdoor sports	7	23.3	19	63.3	4	13.3	0.68
Indoor sports	7	23.3	15	50.0	8	26.7	
No sports	7	23.3	15	50.0	8	26.7	

ence was not statistically significant ($p > 0.05$). In our study, no significant difference was found between the BMI of those who used vitamin D supplements and those who did not ($p > 0.05$). When the dietary habits of the groups and the foods they consumed were compared, no significant difference was found between the groups. BMI was 21.03 ± 2.94 for those who do sports outdoors, 23.51 ± 3.31 for those who do sports indoors, and 24.06 ± 5.22 for those who do not do any sports (Table III). The difference was statistically significant ($p < 0.001$). There was no difference between those who do sports indoors and those who do not. 25-OH vit D was found to be 30.75 ± 11.54 in outdoor sports, 21.59 ± 7.04 in indoor sports, 22.77 ± 3.16 in non-athletic participants, the difference was statistically significant ($p < 0.004$). There was no difference between those who do sports indoors and those who do not. The 25-OH vit D levels of those who do outdoor sports were significantly higher than those who do sports indoors and those who do not ($p < 0.003$ and $p<0.001$, respectively).

Phosphorus levels were 3.42 ± 0.79 in those who do outdoor sports, 3.82 ± 0.78 in those who do indoor sports, and 3.28 ± 0.50 in those who do not do any sports. The difference was statistically significant ($p < 0.04$). Phosphorus was significantly higher in indoor sports than in other groups ($p < 0.01$). Total cholesterol levels are 150.63 ± 6.09 in those who do sports outdoors, 150.92 ± 4.56 in those who do sports indoors, and 169.61 ± 6.57 in those who do not do any sports. Total cholesterol was significantly lower in those who do sports indoors and outdoors compared to those who do not ($p < 0.02$ and $p < 0.03$, respectively).

Calcium levels were found to be 13.01 ± 3.03 in outdoor sports, 9.64 ± 0.33 in indoor sports, 12.72 ± 0.50 in non-athletes, and the difference was statistically significant ($p < 0.009$). The serum calcium level was significantly higher in those who do sports outdoors and those who do not, compared to those who do sports indoors ($p < 0.02$ and $p < 0.03$, respectively). When the time of sun exposure and 25-OH vit D levels was compared, the mean value of 25-OH vitamin D in those exposed to the sun until noon was 22.58 ± 1.52 hours, and 30.77 ± 2.71 in those exposed after 12 pm. The difference was statistically significant ($p < 0.01$).

Regarding the hours spent outside of the study group, which parts of the body were exposed to the sun, the use of vitamin D supplements, the use of sunscreen, and 25-OH vit D values, no significant difference was found between the groups ($p > 0.05$). No correlation was found between 25-OH vit D levels and BMI cholesterol, waist/hip ratio, and serum fatty acids. There was a weak positive correlation between the groups (not doing sports, doing sports indoors, doing sports outdoors) and 25-OH vit D levels, and a negative correlation between total cholesterol, BMI, waist/hip ratio (Table IV).

There was a moderate positive correlation between waist/hip ratio and total cholesterol and triglycerides and a weak negative correlation with HDL. There was a moderate positive correlation between BMI and total cholesterol and triglyceride levels (Table V).

Table IV. Correlation of doing sports with lipid profile, BMI and waist/hip ratio.

Sport Venue	T. Cholst.		Trigl.		HDL		25-OHvit D		BMI		Waist/hip ratio	
	rho	*p*	rho	*p*	rho	*p*	rho	*p*	rho	*p*	rho	*y*
**	-.238	0.02	-.040	0.71	.191	.07	.33	0.00	-.289	.008	-.258	0.02

**Not doing sports, Closed area, Open area. BMI: body mass index; HDL: high-density lipoprotein.

Table V. Correlation of BMI and waist/hip ratio with lipid profile.

Body area	Total cholesterol		Triglyceride		HDL	
	rho	p	rho	p	rho	p
Waist/hip ratio	.480	0.00	.570	0.00	-.216	0.05
BMI	.336	0.02	.427	0.00	-.228	0.37

HDL: high-density lipoprotein; BMI: body mass index.

Discussion

In this study, we aimed to compare the individuals who do sports in indoor and outdoor areas and sedentary individuals in terms of body fat content, vitamin D, and obesity values.

When asked about the use of protective cream in our study, 63.3% (57 participants) stated that they did not use it, 31.1% (28 participants) stated that they used it in the summer season, and 5.6% (5 participants) stated that they used it constantly (Table II). When the literature was examined, there was a study[16] in which the use of sunscreen creams was high, and there was a study[17] with a low rate in parallel with our study. The reason for the high results of the study was thought to be due to the high socio-cultural and socio-economic status of the sample group.

In our study, when those who took vitamin D supplements and multivitamins were questioned, 45.5% of the participants stated that they used vitamin D, and 14.4% stated that they used multivitamins (Table III). In a study conducted with athletes, the use of vitamin D was found to be high in winter months and low in other months. When other studies[18-20] were examined, it was determined that the use of multivitamins was higher in young participants compared to the elderly and that the use of vitamin D supplements was higher in athletes. In addition, individuals using vitamin D supplements in our study were found to have higher 25-OH vit D levels. In the results of different studies[21,22] a positive relationship was found between vitamin D supplementation and serum 25-OH vit D[21], there was not enough evidence that vitamin D use reduced BMI[22]. In our study, no relationship was found between 25-OH vit D levels and BMI, and no relationship was found between 25-OH vit D levels and BMI, as also shown by a similar study[18]. The reason for this may be the low number of obese individuals according to BMI.

In our study, no correlation was found between 25-OH vit D and triglyceride, HDL, and total cholesterol. In another study[23], although TGL and low-density lipoprotein (LDL) levels were found to be lower and HDL levels higher in patients with high 25-OH vit D levels compared to the other group, no statistical difference was found. In another study[24], it was found that 25-OH vit D and HDL were positively correlated, while triglycerides and LDL were negatively correlated. This may be because our study was conducted in healthy young adults, and almost all of them had normal lipid profiles. In our study, when the time they were exposed to the sun and 25-OH vit D levels were compared, it was found to be higher in those exposed after 12 pm, and this was supported by the results of a previous study[25]. In our study, a positive correlation was found between BMI, triglyceride, and total cholesterol. A different study supports our result[26].

In this study, when BMI is compared to those who do outdoor and indoor sports, the BMI of those who do outdoor sports is significantly lower than the other groups (Table IV). There were studies with similar results[27] and with opposite results[28]. In addition, 25-OH vit D was found to be significantly higher in outdoor sports than in indoor sports. Again, many studies support our result[28-32]. In our study, there was a weak positive correlation between the groups (when they were listed as sedentary, indoor sports, outdoor sports) and 25-OH vit D levels, and there was a weak negative correlation between total cholesterol, BMI, waist/hip ratio.

Limitations

This study has some limitations. Firstly, the study had a small sample size. Vitamin D supplement research was limited to vitamin D_3. By varying the parameters in serum samples, the relationship with body mass index can be investigated.

Conclusions

In our study, the 25-OH vit D levels of individuals who do outdoor sports were found to be statistically significantly higher than those who do not. This result showed that doing sports in the open field is effective and important in benefiting more from the sun and in the synthesis of vitamin D. A significant decrease was found in BMI in individuals who do sports outdoors compared to individuals who do indoors or do not do any sport. Low BMI levels indicate that it may be a protective factor from obesity. Low BMI levels and exposure to vitamin D on the skin in the open air showed that it may be a protective factor from obesity. As a result of this study, we think that outdoor sports and physical activity should be recommended for maintaining a healthy life and preventing metabolic diseases. There is a need for studies with larger samples and different age groups on this subject.

Data Availability

All data used to support the findings of this study are available from the corresponding author upon request.

Ethics Approval

All experimental procedures have been approved by Van Training and Research Hospital Clinical Researches Local Ethics Committee with the decision dated and numbered (Date: 12/04/2018, Numbered: 07).

Conflict of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

SCD and STC planned and designed the research, wrote the manuscript, and are responsible for the final content. ZP, ZO, and EA contributed to the conduct of the research, data collection, and analysis. SCD, STC, ZP and ZO wrote the draft of the manuscript. All authors read and gave final approval of the version to be published.

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Informed Consent

Voluntary consent was obtained from the research group, which consisted of 90 participants in total. All individuals participating in the study were asked to fill in an informed voluntary consent form, which was signed and archived.

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