

Research Paper

Investigating the Changes of Tumor Necrosis Factor- α and Interleukin-10 After 8 Weeks of Regular Pilates Exercise and Vitamin D Intake in Overweight Men: A Randomized Clinical Trial



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ABSTRACT

Background and Aim Weight gain and vitamin D deficiency are associated with increased systemic inflammation and chronic diseases. The current study aimed to investigate the effects of regular Pilates training associated with Vitamin D intake on Tumor Necrosis Factor- α (TNF- α) and Interleukin-10 (IL-10) levels in overweight males.

Methods & Materials This quasi-experimental study was conducted on 52 overweight men aged 45-55 years. Volunteers were firstly selected through the convenience sampling method. Then, they were divided into Pilates training, Pilates training + vitamin D supplementation, vitamin D supplementation (combined), and control groups (n=13/group). The provided Pilates training program was performed for 8 weeks (with the intensity of 50%-75% of reserve heart rate, 3 sessions/week). The supplement and combined groups also received 50000 units of oral vitamin D weekly for 8 weeks. The serum levels of variables were determined using the ELISA method. The obtained data were analyzed by Paired Samples t-test, one-way Analysis of Variance (ANOVA), and Kruskal-Wallis test at the significant level of <0.05.

Ethical Considerations This study was approved by the Research Ethics Committee at Islamic Azad University, Babol Branch, Iran (Code: IR.IAU.BABOL.REC.1398.088). Also, this study was approved by the Iranian Clinical Trial Registration Center (Code: IRCT20190831044650N2)

Results The collected results indicated that 8 weeks of Pilates training, vitamin D intake, and the combined intervention were associated with a significant increase in IL-10 (P<0.001) and a decrease in TNF- α (P<0.001). Additionally, the presented combination intervention was associated with further alternations in the research variables, compared to the other two interventions; however, in the exercise group, the decrease in TNF- α level was more than that in the vitamin D intake group (P=0.012).

Conclusion It seems that in overweight combined with vitamin D deficiency stats, the anti-inflammatory effects of Pilates training, vitamin D supplementation interventions, and a combination of the two methods can be attributed in part to up-regulation IL-10 and TNF- α reduction; however, the effectiveness of the combined intervention on the development of inflammation was greater than that of the other two interventions. Furthermore, the effect of Pilates training on reducing TNF- α was stronger than that of vitamin D supplementation.

Key words:

Interleukin-10, Overweight, Pilates training, Vitamin D, Tumor necrosis factor- α

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Extended Abstract

1. Introduction

Obesity causes low-grade chronic inflammation and immune system disorders [2]. Systemic inflammation is characterized by increased levels of biomarkers, like Alpha Tumor Necrosis Factor (TNF- α) [3]. Interleukin 10 (IL-10) is an essential anti-inflammatory and immune-regulating cytokine involved in controlling the inflammatory response [4]. Vitamin D deficiency is also strongly linked to major chronic diseases, such as cardiovascular disease, diabetes, and cancer [7]. The bioactivity of this vitamin may decrease with increasing adipose tissue in obese individuals [8]. Vitamin D manifests various regulatory effects on acquired and innate immune system cells [12]. The active metabolite of vitamin D significantly impacts the negative regulation of TNF- α expression and production [3]. Additionally, the low concentrations of inflammatory markers were observed in individuals with frequent and more intense physical activity [14]. Therefore, reducing inflammation is a therapeutic goal to decline the risk of disease and disability. The present study explored the effect of regular Pilates exercises plus vitamin D intake on TNF- α and IL-10 levels in overweight men.

2. Materials and Methods

This was a quasi-experimental study with a pre-test-Post-test and a control group design. The present study was performed on 52 inactive overweight men [Body Mass Index (BMI): 25-29 kg/m²], with an age range of 45-55 years. The research subjects were selected by convenience sampling method; then, they were randomly divided into the exercise, exercise + vitamin D (combination), vitamin D supplementation, and control groups (n=13/group). Each

training session consisted of 3 parts; warm-up (10 minutes), basic Pilates exercises, and cool-down (5 minutes). The main exercises started in the first week with an intensity of 50%-55% of the reserve heart rate, one set, and 10 repetitions, and continued until the eighth week with an intensity of 65%-70% of the reserve heart rate, 4 sets with 12 repetitions (a gradual increase of 5% intensity training, one set & 2 repetitions every two weeks) [18]. Vitamin D and Perl combination groups received vitamin D, IU50000, and Perl control group containing oral paraffin once a week for 8 weeks as a single-blind [19]. The serum levels of the relevant variables were determined using the ELISA method. The obtained data were analyzed using Paired Samples t-test, one-way Analysis of Variance (ANOVA), and Kruskal-Wallis test at a significance level of P<0.05.

3. Results

Based on the Shapiro-Wilk test and one-way ANOVA data, the research subjects were similar concerning anthropometric indices and baseline vitamin D levels (Table 1). Furthermore, 40% of the explored subjects presented insufficient vitamin D levels (29-20 ng/mL) and another 60% had vitamin D deficiency (<20 ng/mL).

The intragroup study results revealed an increase in IL-10 levels and a decrease in TNF- α after 8 weeks of vitamin D intake, Pilates exercises, and combined intervention. Moreover, there was a significant difference between the mean scores of IL-10 and TNF- α in the post-test and the frequency of their changes in the research groups (Table 2). Based on the post hoc test data, the experimental groups presented higher IL-10 and lower TNF- α levels, compared to the control group; however, no significant difference was observed between the mean levels of TNF- α and IL-10 in the post-test (Table 3).

Table 1. Mean \pm SD scores of anthropometric indices and 25-hydroxyvitamin D levels in the research subjects

Group	Mean \pm SD				
	Height (cm)	Weight (Kg)	Age (y)	BMI (Kg/m ²)	25-Hydroxyvitamin D Research (ng/mL)
Pilates exercise	181.4 \pm 3.58	93.41 \pm 2.78	48.92 \pm 3.58	28.39 \pm 0.87	17.50 \pm 5.42
Vitamin D	180.84 \pm 7.30	92.93 \pm 3.12	49.54 \pm 2.37	28.42 \pm 1.01	18.00 \pm 4.55
Pilates Exercise + Vitamin D	179.77 \pm 1.64	92.31 \pm 4.07	49.00 \pm 3.32	28.51 \pm 1.04	17.61 \pm 4.61
Control	179.77 \pm 1.64	91.92 \pm 3.55	49.58 \pm 2.84	28.33 \pm 0.61	17.75 \pm 4.51
F	0.895	0.455	1.293	0.082	0.025
P *	0.451	0.715	0.921	0.970	0.994

*P obtained from one-way ANOVA.

Table 2. Comparing the within and between-group changes in the studied variables at baseline and after 8 weeks

Variable	Group	Mean±SD		The Frequency of Changes (%)	Intragroup Comparison
		Pre-test	Post-test		
IL-10 (pg / ml)	Pilates exercise	8.11±1.01	9.77±1.23 #	20.43±3.94#	P<0.001
	Exercise	7.91±1.21	9.51±1.30 #	20.51±3.45 #	P<0.001
	Pilates exercise + Vitamin D	8.36±1.21	10.57±1.36 #	26.87±4.50 # [£] &	P<0.001
	Control	7.94±1.11	7.91±1.07	-0.52.0±0.88	P=0.104
Inter-group comparison of IL-10 mean in post-test			P<0.001	F=9.888	
Intergroup comparison of IL-10 percentage changes			P<0.001	χ ² =34.684	
TNF-α (picograms / ml)	Pilates exercise	7.41±1.27	6.06±0.99 #	-18.07±-4.12 #	P<0.001
	Exercise	6.96±1.46	6.01±1.28 #	-13.55±-4.01 # [£]	P<0.001
	Pilates exercise + Vitamin D	7.47±1.26	5.73±1.11 # [£]	-23.40±-3.69 # [£] &	P<0.001
	Control	7.24±1.13	7.29±1.12	0.8±1.35	P=0.065
Intergroup comparison of mean TNF-α in post-test			P=0.007	F=4.579	
			P<0.001.0	F=108.106	

#Significant difference compared to the control group; [£]Significant difference compared to the Pilates training group; [&]Significant differences compared to the vitamin D group.

Pairwise comparison of the mean frequency of changes in the mean scores of the variables indicated a further decrease in TNF-α levels and a higher increase in IL-10 following Pilates training interventions, and vitamin D supplementation, compared with the controls. However, the effect of the combined intervention on reducing TNF-α levels and IL-10 positive regulation was greater than those of the other interventions (Table 3).

4. Discussion and Conclusion

The present study findings indicated an unfavorable status of vitamin D in overweight men. In other words, 40% and 60% of the explored subjects had insufficient levels and vitamin D deficiency, respectively. Furthermore, 8 weeks of Pilates training, vitamin D intake, and combination intervention were associated with decreased TNF-α levels and the positive regulation of IL-10. It seems that inactivity

Table 3. Results of mean tangential tests and the frequency of changes in research variables

Groups	Mean TNF-α in Post-test ^a (P)	Frequency of changes in mean TNF-α ^a (P)	Mean IL-10 in Post-test ^a (P)	Frequency of average changes ^b IL-10 (P)	
Vitamin D	= 0.034	< 0.001	= 0.013	< 0.001	
Control	Pilates exercise	= 0.049	< 0.001	= 0.004	< 0.001
	Pilates exercise	= 0.007	< 0.001	< 0.001	< 0.001
Vitamin D	Pilates exercise	= 1.000	= 0.012	= 0.955	= 0.894
	Pilates exercise + Vitamin D	= 0.924	= 0.002	= 0.146	= 0.001
Exercise	Pilates exercise + Vitamin D	= 0.895	<0.001	= 0.382	= 0.002

^a P-value from Tukey's post hoc test; ^b P-value from Mann-Whitney U test.

and vitamin D deficiency can lead to an increase in inflammatory status in overweight populations, i.e., improved by practicing Pilates exercises and taking vitamin D. Vitamin D exerts its anti-inflammatory effects by inhibiting NF- κ B, mitogen-activated protein kinase signaling pathways, and reducing the expression of Toll-like receptors. The active metabolite of vitamin D regulates NF- κ B and inhibits dendritic cell differentiation and lymphocyte proliferation [24]. IL-10 also exerts its inhibitory effect on TNF- α secretion by reducing cholesterol accumulation in THP-1 macrophages derived from foam cells [31]. Exercise can modulate intracellular signaling pathways and cellular function mediated by nitric oxide and Reactive Oxygen Species (ROS). ROS mediates some catabolic effects of TNF- α on skeletal muscle; accordingly, decreased ROS production may lead to a reduced inflammatory response [13].

According to the obtained data, Pilates exercises, vitamin D intake, and combination intervention could improve inflammatory status in overweight subjects with low vitamin D levels. This is achieved by decreasing TNF- α and positively regulating IL-10. However, the effect of the combined intervention in modulating systemic inflammation was greater, compared to those of the other interventions. Therefore, exercise can exert some of its supportive effects on obesity and overweight by reducing inflammation, i.e., exacerbated by vitamin D intake.

Ethical Considerations

Compliance with ethical guidelines

All stages of the research were conducted under the supervision of Sports experts, observing ethical points. Furthermore, the present study was approved by the Iranian Clinical Trial Registration Center (Code: IRCT20190831044650N2) and the necessary Ethics Code was also obtained (IR.IAU.BABOL.REC.1398.088).

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Authors' contributions

Conceptualization, writing – original draft, data analysis: Masoumeh Habibian; Methodology, data collection, writing – review & editing: Masoumeh Khodadoost.

Conflicts of interest

The authors declared no conflicts of interest.

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