



The Effect of Eight Weeks of Hand-Selected Strength Exercises and the Cinnamon Supplementation on Inflammatory Biomarkers in Elderly Women with Osteoarthritis

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Abstract

Background: Osteoarthritis is the most common joint disease (arthropathy) and a cause of disability in aging ages. The prevalence rate of the osteoarthritis is different and is related to different indicators.

Objectives: The purpose of the present study was to investigate the effect of eight weeks of hand-selected exercises and cinnamon supplementation on inflammatory biomarkers in elderly women with osteoarthritis.

Methods: The participants of this study were 48 women with hand-osteoarthritis. They divided into four groups (strength exercises, cinnamon-honey supplementation, combinatory and control) randomly. The first group underwent the hand-selected strength exercises. The second group used the supplementations for 8 weeks. The third group also applied hand-selected exercises and supplements simultaneously. The fourth group also participated as a control group without any exercise or supplementation. Patients' TNF α and IL6 levels were measured before and after applying the independent variables and were compared. The dependent *t*-test was used to compare between pre and posttest and the ANOVA test to compare TNF α and IL6 levels between the four groups. The significance level $P \leq 0.05$ was considered.

Results: The results showed that by applying variables, the strength exercises and cinnamon-honey supplementary as well as the combination of exercises and supplementary have had a positive effect on inflammatory biomarkers and in fact, 8 weeks of resistance exercises and using cinnamon-honey supplements in women with hand osteoarthritis have led to a decrease in IL 6 and TNF α levels.

Conclusions: Therefore, it is recommended to use wrist resistance exercises with supplements (cinnamon and honey) to accelerate the recovery of the disease and improve the wrist inflammatory.

Keywords: Osteoarthritis, Cinnamon, Honey, Strength Exercises, Inflammatory Biomarkers

1. Background

Osteoarthritis is the most common joint disease (arthropathy) and a cause of disability in aging ages. The prevalence rate of the osteoarthritis is different and is related to different indicators. After the knee, with a prevalence of 33%, wrist osteoarthritis with a prevalence of 5.29% is the most common joint that affected. Research has shown that its prevalence in women is almost twice that of men. Also It often occurs in people over 55 years of age (1).

Based on the number of joints involved, there is a classification of osteoarthritis, which includes generalized osteoarthritis with involvement of more than 3 joints and localized osteoarthritis with involvement of less than 3

joints. In idiopathic osteoarthritis, localized involvement mainly involves involvement of the first carpometacarpal joints, the Heberden, the Bouchard and the knees and thighs (2).

A better cognition of the pathogenesis of the disease indicates that numerous local or general factors are involved in the development and progression of osteoarthritis (3, 4). Some of these factors include age, sex, race, genetics, bone density, sex hormones (estrogen, testosterone) endocrine or metabolic disorders, nutrition, obesity, major joint injuries, excessive pressure on joints caused by occupation or exercise, congenital and developmental disorders and defects in joint or ligamentous laxity and previous history of inflammatory or infectious arthritis (3, 4).

According to research, it can be concluded that both cy-

tokine interleukin 6 (IL6) and tumor necrosis factor alpha (TNF α) are responsible for altering cartilage homeostasis in degradation and catabolism of the joint, which causes to induce inflammatory process and to activate the parsers mediators of the joint and apoptosis (5).

Different ways have been suggested to reduce the effects of the disease:

Such as: Patients' awareness, proper nutrition, drug therapy and finally, exercise programs which each have its own significant benefits. Different studies on the medicinal plants and their constituents have demonstrated the anti-inflammatory effect of cinnamon. Various studies have also reported the anti-inflammatory properties of cinnamon and cinnamon oil. Also, the use of honey either in the form of feed or for topical use has reduced inflammation and pain in various joint diseases. It seems that the soothing effect of cinnamon on the arthritis progression is done without affecting the antibody response, which is due to its anti-inflammatory effect. Therefore, cinnamon and honey as a complementary therapy can be useful for the treatment of arthritis (6, 7).

Another important component of osteoarthritis healthcare in the elderly is exercise therapy. Exercise involves planned, regular and organized movements to improve or maintain one or more physical and motor fitness factors (8). Physical activity and exercise are key recommendations for the management of osteoarthritis of the hands and fingers. It is worth noting that studies have reported different results (9). Exercise has had from low to medium effects on reducing pain and inflammatory biomarkers, which have been reported by researchers. It seems that exercise is also likely to be effective in osteoarthritis, although limited evidence is available (10).

However, there is some debate as to which exercise and which type of exercise has the benefit or risk of progression of OA. This may be due to the evaluation of the effect of physical activity or new disease-modifying OA drugs which is currently based on radiographic criteria (e.g., Width space of articular) and non-correlation with clinical signs and symptoms (e.g. Pain and loss of strength and motor function). In addition, OA specifically manifests itself as a change in common space and bone (10).

Certainly, patients with this disease are looking for ways that, in addition to the best performance, has the least harm. The use of painkillers and corticosteroids reduces pain in patients, but the long-term adverse effects will occur with the onset of some diseases.

2. Objectives

In this regard, safe and low-cost methods include different exercises as well as changing eating habits. The benefits of using exercise and supplements have been studied in previous researches, but neither of these studies has jointly examined these two important factors and in addition, has not examined the variables involved in the disease in this way. Most of the studied researches have investigated a few factors separately and in some cases, the reported results have been contradictory. Therefore, in this study, the researcher is trying to investigate the effect of 8 weeks of hand-selected strength exercises and cinnamon and honey supplementation on some inflammatory biomarkers of patients with osteoarthritis.

3. Methods

This is a quasi-experimental study with pre-test and post-test design with a control group. The statistical population of this study consisted of all women with hand osteoarthritis who have referred to Imam Reza Medical Center in Kermanshah. Among the people referred to this center, 48 were selected as a specimen and randomly divided into four groups of selected strength exercises ($n = 12$), cinnamon-honey supplement ($n = 12$), combinatory ($n = 12$) and control ($n = 12$).

In this study, the first the levels of TNF α and IL6 biomarkers were measured and after applying the practical and complementary interventions, the mentioned variables were again measured and recorded in four groups after eight weeks. The subjects participated in the pre-test after completing the consent form and demographic questionnaire. Subjects had to answer the following questions:

Age, history of physical activity, history of skeletal problems, history of severe osteoporosis, history of Parkinson's disease, history of stroke or neuropathy, history of severe lumbar disc or orthopedic problems, ability to walk without the need for assistive devices, sufficient vision and hearing and work experience.

3.1. Method of Blood Sampling and Measuring Variables

To measure TNF α and IL6 levels, 5 mL of blood was sampled from the brachial vein 24 hours before the start of the first session and supplementation use as well as 24 hours after the last exercises session in the fasting state. The samples were then centrifuged at 20,000 rpm for 20 min using a laboratory method and analyzed using ELISA kit.

3.2. Procedure

The hand strength exercises intervention was performed for 8 weeks as suggested by Hennig et al. (Figure 1). In this group, standard hand strengthening exercises was performed using simple tools (11). The second group used honey supplements and cinnamon powder twice a day for 8 weeks. The third group also received hand-selected exercises and cinnamon and honey supplements simultaneously. The fourth group also participated in this study without any exercise or supplementation and as a control group. Patients' TNF α and IL6 levels were measured before and after applying the independent variables and compared with each other (11-13).

According to Hennig's suggestion et al. (11), dosage of the honey and cinnamon is two tablespoons of honey daily (every morning) with one teaspoon of cinnamon dissolved in a cup of water.

Descriptive statistics were used to adjust and classify the data, calculate central tendency and dispersion indices such as mean and standard deviation as well as draw charts. For inferential analysis after examining the normality of the data by Shapiro wilk test, dependent *t*-test was used to compare between pretest and posttest groups and ANOVA test to compare TNF α and IL6 levels between the four groups. Data analysis was performed by SPSS software version 23 and the significance level $P \leq 0.05$ was considered.

4. Results

Table 1 shows the mean and standard deviation of the individual characteristics of the subjects in the four groups of control, strength training, cinnamon and honey supplementation and combination group.

Also the frequency, mean and standard deviation of TNF α (pg/mL) and IL6 (pg/mL) levels during the pre-test and post-test are shown in the following table (Table 2) in all four groups.

In this study, the Shapiro-Wilk test was used to determine the normality of the data distribution. The results showed that the distribution of data in the variables TNF α (pg/mL) and IL6 (pg/mL) was normal in both pre-test and post-test. Therefore, parametric statistics were used to investigate the research hypotheses. To investigate the effect of strength exercise, cinnamon-honey supplementation and combinatory, a pre-test and post-test intra-group design (t-dependent) was used for all four groups. The results showed that there is significant difference in the pre-test and post-test in all three variables in the control group, but there was significant difference in the pre-test

and post-test in all variables TNF α and IL6 in the Cinnamon-Honey supplementation, strength training group and the combinatory group. These results indicate that the application of the independent variable has a significant effect on the subjects in all three experimental groups and in all three variables.

In this study, ANOVA test was used to investigate the differences between groups. Comparison between groups in all variables in the pre-test showed that there was no significant difference between the groups (strength training, cinnamon-honey supplement, combinatory and control groups). But the comparison between the four groups at the post-test showed that there was a significant difference between the four groups at this stage.

Tukey test at 0.05 was used to investigate the differences between groups. Tukey post hoc test for variable TNF α showed that there was a significant difference between the four groups at posttest (Table 3).

This means that both strength training and the use of cinnamon-honey and combination supplements have been able to reduce TNF α (pg /mL). Tukey post hoc test for IL6 showed that there was no significant difference between strength training group and cinnamon and Honey supplement in the post-test phase. There was also a significant difference between the strength training, combination and control groups as well as the other groups.

5. Discussion

The results showed that implementation of the strength exercise, cinnamon-honey supplementation and combination of exercises and supplementation could have a positive effect on inflammatory biomarkers. It is also worth noting that, eight weeks of resistance training and the use of cinnamon-honey supplementation and combinatory in women with wrist osteoarthritis has led to decrease levels of IL6 and TNF α .

The results of the current study showed that IL6 level was significantly decreased. Numerous studies, such as those of Yamaoka-Tojo et al. (14) and Kohut et al. (15), have shown that regular physical activity has anti-inflammatory effects and is a treatment for a range of inflammatory diseases. In a study, Kohut et al. (15) examined the effect of physical activity on inflammatory factors in the elderly, and in their study, subjects performed aerobic exercise on a treadmill, hand-held ergometer, and bicyclist 3 times a week for 10 months. In their study, intensity of activity started from 45 to 60 percent of maximal heart rate and increased to 60 to 70 percent then percent of maximal heart rate was maintained between 65 to 80 percent for 10



Method of exercise	Description
	1- Warm up the hand by rubbing a hand cream
	2-Slide your thumb to the side of the finger and bring it to 0. Then open your fingers and then do the same with other fingers
	3-Bend your fingers from the joint of second strap of finger (flexion) and then bend from the first strap of finger and palm bones, then bend your thumb, then hold for a few seconds, then open your fingers
	4-Grasp the massage ball with all your fingers and press it firmly. Pause for 5 seconds and repeat the movement.
	5-Loop a strip around your fingers and keep your fingers apart. Pause for 5 seconds and repeat the movement again
	6-Put one hand on the other and apply pressure. Open your fingers with pressure when your wrist is flat. Now, hold for 5 seconds and then go back to the original mode

Figure 1. Hand strength exercise protocol (11)

months. The results showed that the IL6 inflammatory factors in the aerobic group had a significant decrease.

In explaining the cause it can be said that physical activity reduces the level of inflammatory cytokines and

Table 1. Mean and Standard Deviation of Individual Characteristics of Subjects^a

Groups	Age, y	BMI, kg/m ²	Weight, kg	Height, cm
Control	60 ± 2.41	27.18 ± 1.19	74.5 ± 4.71	165.58 ± 2.42
Strength training	59.5 ± 1.73	25.97 ± 2.06	72.75 ± 7.18	167.25 ± 3.98
Cinnamon and honey supplements	59.5 ± 4.81	27.2 ± 1.65	75.58 ± 4.64	166.75 ± 4.67
Combinatory	59.08 ± 2.57	26.54 ± 2	74.08 ± 5.56	167.08 ± 4.18

^aValues are expressed as mean ± SD.**Table 2.** Mean and Standard Deviation of Research Variables in Four Groups (Control, Strength Training, Cinnamon and Honey Supplement and Combinatory)^a

Groups	IL6 Level, pg/mL		TNFα Level, pg/mL	
	Pre-Test	Post-Test	Pre-Test	Post-Test
Control	1.46 ± 0.08	1.43 ± 0.08	3.05 ± 0.15	3.03 ± 0.13
Strength training	1.39 ± 0.11	1.18 ± 0.09	3.03 ± 0.13	2.06 ± 0.16
Cinnamon and honey supplements	1.45 ± 0.1	1.19 ± 0.09	3.05 ± 0.16	1.83 ± 0.107
combinatory	1.45 ± 0.1	1.05 ± 0.1	3.02 ± 0.105	1.41 ± 0.093

^aValues are expressed as mean ± SD.**Table 3.** Tukey Post Hoc Test to to Examine the Differences Between Groups in TNFα Variable and IL6 Levels

Variable	Mean Differences	P Value
TNFα, pg/mL		
Strength exercise		
Cinnamon-honey supplement	0.233 ^a	0.0001
Combinatory	0.65 ^a	0.0001
Control	0.966 ^a	0.0001
Cinnamon-honey supplement		
Combinatory	0.416 ^a	0.0001
Control	-2.1 ^a	0.0001
Combinatory		
Control	-1.616 ^a	0.0001
IL6, pg/mL		
Strength exercise		
Cinnamon-honey supplement	-0.008	0.997
Combinatory	0.125 ^a	0.013
Control	-0.25 ^a	0.0001
Cinnamon-honey supplement		
Combinatory	0.133 ^a	0.0001
Control	-0.241	0.0001
Combinatory		
Control	-0.375 ^a	0.0001

^aSignificance level at the difference between the means is 0.05.

increases the production of anti-inflammatory cytokines such as IL6. The production of anti-inflammatory cytokines decreases the production of pro-inflammatory cytokines from adipose tissue (16).

Beta-adrenergic receptor activity is a mechanism that mediates the changes in inflammatory mediators induced by exercise and dietary supplementation. The activity of adipocytes Beta-adrenergic receptor increases the secretion of pro-inflammatory cytokines. Exercise reduces the beta-adrenergic receptor density (16, 17). Also, the results of this study showed that CRP levels were significant difference to pre-test. In a study by Colbert et al. (18), they found that after six months of physical activity, CRP levels did not change significantly, which was not consistent with the results of the present study. Another study reported that increasing men's physical activity to about 30 minutes of walking per day had no significant effect on CRP values. The reason for this may be due to the duration and type of exercise (19).

In another study which carried out on 424 elderly men and women, the effect of 12 months of walking for 150 minutes per week on serum IL6 levels was examined. The results showed that after 12 months of physical training, the level of IL6 decreased significantly (20). Due to the increased inflammatory index induced by age and its relationship to the fat mass in the body the most likely reason for the finding differences is due to differences in age and physical status of the participants in the present study with their research (21).

Basically, IL6 and TNFα are indicators that most re-

searchers expect to change during different exercise activities, but according to research, the rate of changes in IL6 and TNF α during exercise is different in healthy individuals (22). The results of the present study are consistent with the findings of Pischon et al. (23), Bolboli (22) and Pourvaghari (24).

Bolboli (22) showed that 8 weeks of aerobic exercise reduce IL6 and TNF α levels in obese and elderly women and considered such exercises as an effective way to prevent and control risk factors for inflammatory diseases. Although the results of numerous studies have confirmed the decrease in IL6 and TNF α , the results of Akhtari Shojaei (25) and Gaini et al. (26) differed. One possible reason for the inconsistency of the findings of the present study with the said research can be attributed to the age difference of the subjects (22).

It is also important to consider both of the intensity and duration of exercise as well as the time interval of blood sampling after end of the intervention for investigating the short-term and long-term effects of exercise on IL6 and TNF α (27). Other possible reasons of inconsistency in the results of the research can be mentioned in the characteristics of the subjects such as their fitness and gender. As physical fitness increases, the level of inflammation associated with physical activity decreases, as well as in men, the rate of inflammation responds to activity is at a low level (28). Regular exercise, by reducing sympathetic stimulation and increasing anti-inflammatory cytokines, inhibits the release of inflammatory mediators from adipose tissue and subsequently reduces the concentration of inflammatory markers (28, 29).

In a research, Pischon et al. (23) studied more than 800 healthy men and women and found that physical activity was inversely correlated with CRP and IL6 levels, as more repetition of physical activity decrease the systemic inflammation and improve insulin sensitivity. However, increased free radicals induced by vigorous exercise are thought to increase the possibility of IL6 and TNF α inflammatory cytokines release (29); therefore, exercise intensity appears to be one of the factors influencing cytokine levels, that should be taken into consideration.

Due to the anti-inflammatory properties of cinnamon and honey and the effect of these substances on free radicals and increase insulin sensitivity, and improve endothelial function, levels of inflammatory markers are also reduced. Interleukins are probably one potential pathway. In particular, there is evidence for the interference of IL6 and TNF α . IL6 and TNF α indices are significantly released from adipose tissue, especially visceral fat. Their release from adipose tissue is enhanced by sympathetic stimulation, and since regular physical activity as well as cinnamon and

honey modulates sympathetic stimulation, it is likely to decrease TNF α , and stimulate the production of IL6 (30). In this regard, the researchers showed that IL6 regulates the secretion of some inflammatory markers from the liver, whereas the main source of IL6 release is adipose tissue (about 30%). Therefore, lowering body fat levels following exercise and consuming honey and cinnamon is probably a factor in modulating IL6 production and ultimately reducing inflammation (31). Also, consuming cinnamon and honey and exercising regularly will increase endothelial nitric oxide and improve endothelial function and increase antioxidant agents. Thus, this process reduces systemic and topical inflammation and, consequently, reduces the production of inflammatory cytokines from the endothelial wall smooth muscle and shows its ultimate effect as a possible reduction of this inflammatory marker in the liver (30, 32).

Footnotes

Authors' Contribution: Shayesteh Hassani designed the experimental set up the study, performed the experiments, and analyzed the data. Sedigheh Hosseinpour Delavare and Hassan Safikhani wrote the manuscript.

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