



The effect of Total Resistance Exercise combined with milk thistle consumption on cardiovascular risk factors in men with hypertension



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ABSTRACT

Introduction: Clinical evidence points to an increase in the prevalence of hypertension in recent years. In this study, we aimed to assess the effect of total resistance exercise (TRX) combined with Milk thistle on cardiovascular risk factor (TG, TC, LDL, HDL) in adult men with hypertension.

Methods: In this quasi-experimental research, 48 adult men with hypertension aged 30-40 years of old with hypertension were randomly divided into control (no intervention); supplement (Milk thistle, 280 mg /daily); exercise (TRX, 3 times/weekly) and combined group (TRX + Milk thistle). The TRX and supplementation intervention lasted 8 weeks. Pre and post intervention of TG, TC, LDL, HDL and anthropometric indexes were recorded for all groups. Data were compared by ANOVA between groups ($p < 0.05$).

Results: A significant difference in all cardiovascular risk factors was observed between the exercise and supplement groups with the control group ($p < 0.001$). On the other hand, milk thistle consumption during TRX training led to a significant decrease in TG and LDL and a significant increase in HDL compared to each of them alone ($p < 0.001$).

Conclusion: The consumption of Milk thistle during TRX is associated with more cardiovascular effects than the application of each of them alone in adult men with hypertension. Understanding the underlying mechanisms responsible for these changes requires further studies.

Keywords: Hypertension, Cardiovascular risk factor, TRX, Milk thistle.

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1. Introduction

Obesity is associated with increased low-density lipoprotein (LDL), triglyceride (TG), and total cholesterol (TC), and decreased (HDL) (1,2). Increased liver access to free fatty acids leads to increased very low-density lipoprotein (vLDL), which ultimately converts vLDL to LDL, which has an atherogenic property. Also, in response to obesity, peripheral vascular resistance increases, which is associated with coronary artery disease and blood pressure (1,3). Therefore, researchers have always sought to develop solutions for cardiovascular abnormalities. In this context, physical activity and exercise have always been relevant. As the findings of the study by Russell et al, (2013) showed that intense and moderate interval training for 4 weeks led to increased levels of adiponectin and HDL, along with decreased cholesterol, triglyceride, and LDL (4). However, some studies have reported no change in serum

levels of cardiovascular risk factors (TC, TG, LDL, and HDL) following long-term training periods (5). Other studies have also observed insignificant reductions in cardiovascular risk factors in response to a weight loss program (6). However, 8 weeks of TRX in the study by Gharah Dashkhany (2023) although it increased total antioxidant capacity, did not affect myeloperoxidase levels (7). Despite the aforementioned evidence, a response or adaptation of cardiovascular risk factors to TRX training has been observed in cardiovascular patients, such as those with lower blood pressure.

TRX, or total body resistance training, which is performed in an intermittent manner, has been developed greatly in recent decades and has been introduced to the world since 1990. A unique exercise that includes two straps and handles and uses body weight as resistance, this exercise can be performed in any place and environment (8). TRX exercise reduces body fat and increases

muscle mass at the same time (9). Therefore, it may be said that TRX is a suitable way to improve cardiovascular risk factors in cardiovascular patients such as people with blood pressure. However, so far, few studies have evaluated the effectiveness of TRX exercises with an emphasis on cardiovascular risk factors in people with blood pressure.

In addition to the aforementioned evidence, some recent studies have investigated the effects of exercise training combined with the use of nutritional supplements, especially antioxidant supplements, on the components determining cardiovascular function. Among nutritional supplements, milk thistle refers to a set of flavonolignan compounds (seven types of flavonolignans: silylin type A, silylin type B, isosilylin type A, isosilylin type B, silychristin, isosilychristin and silydianin and one taxifolin) found in the seeds of the milk thistle plant with the scientific name *Silybum marianum* with antioxidant properties (10). Regarding the cardiovascular effects of milk thistle, it can be noted that reducing cholesterol absorption and its consequence, reducing cholesterol and LDL while significantly increasing HDL are also beneficial effects of milk thistle (11).

Baluchnejad et al, have also indicated that milk thistle consumption leads to a decrease in triglyceride, total cholesterol, LDL, and glucose levels, as well as an increase in HDL and an improvement in the oxidative stress profile in diabetic mice (12). In addition to the aforementioned evidence that points to the cardiovascular effects of both TRX training and milk thistle consumption, so far, no study has evaluated the effect of TRX training combined with milk thistle consumption on cardiovascular risk factors in people with hypertension. Therefore, the present study was designed and investigated with the main aim of determining the effect of TRX training combined with milk thistle consumption on TG, TC, LDL, HDL, and CRP levels in people with hypertension.

2. Methods

Subjects

The statistical population of this semi-experimental study consisted of obese adult obese men with hypertension aged 30 to 40 years of old. The study sample consisted of 48 obese adult

men with hypertension who were randomly assigned to 4 groups: exercise (8 weeks of TRX, 3 sessions / weekly), supplement (8 weeks of milk thistle extract consumption, 280 mg daily), combined (TRX + milk thistle, 8 weeks), and control group (no intervention).

Inclusion and exclusion criteria

Blood pressure values above 140/90 mmHg were considered as the main inclusion criterion. The study subjects are non-athletes and non-smokers. They have not participated in a regular exercise program in the past 6 months. They have not been on a weight loss diet in the past 6 months and their weight has fluctuated less than one kilogram. A history of kidney disease and cancer, as well as epilepsy and seizures are among the inclusion criteria. Failure to participate regularly in exercise sessions and failure to take supplements or having any disease that affects the dependent variables are among the exclusion criteria.

Anthropometric measurements

Anthropometric indices were measured in all groups before and after the intervention. Height was measured using a wall-mounted height gauge, without shoes, with an accuracy of 0.1 cm. Abdominal circumference were measured after a normal exhalation at the thickest area with an inelastic tape measure with an accuracy of less than 0.1 cm. Weight was measured using a Seca trouser with an accuracy of 0.5 kg. Body mass index was measured by dividing weight (kg) by height (m²). Body fat percentage was measured using a body composition measuring device (OMRON, Finland).

TRX intervention, supplementation method and blood sampling

The subjects were randomly divided into 4 groups: control, supplement, exercise, and combination (supplement + TRX). The supplement group consumed milk thistle for eight weeks (2 tablets of 140 mg of Livergel daily, twice a day, morning and afternoon) and were prohibited from participating in any sports activities. The exercise group experienced TRX for eight weeks, three sessions per week. The combination group (supplement + TRX) also experienced TRX training for eight weeks along with consuming Livergel extract. The control group continued their normal lifestyle for 8

weeks and did not any exercise program.

Blood sampling was performed after 10 to 12 hours of overnight fasting (fasting) between 8 and 9 a.m. The subjects were asked to refrain from any heavy physical activity for 48 hours prior to blood sampling. Blood sampling (5 ml) was performed from the left arm vein of each subject in a sitting position for measuring variables (pre-test).

TRX was performed for 8 weeks with three 20-minute sessions in the first two weeks, which increased to 50 minutes in the last two weeks. The step-by-step loading method (measuring the slope and markings on the ground) was performed every two weeks. In the following sessions, the intensity of the training was gradually increased by increasing the number of exercises and the time of activity in the session (13). The number of exercises increased from 12 movements (4 upper body, 4 middle body, 4 lower body) to 24 movements (8 upper body, 8 middle body, 8 lower body). The intensity of each individual's activity was controlled with the RPE pressure perception scale. Thus, before starting the exercises, the subjects were familiar with this scale and its range. In order to standardize the way in which the training movements were performed, the speed of the movements was standardized in all subjects by a metronome of one beat per second. The control and supplement groups did not participate in the exercise program. Finally, 48 hours after the last training session, anthropometric measurements and blood

sampling were performed again. Cardiovascular risk factors (TC, TG, LDL, HDL) were measured by calorimetric method (Pars Azmoun, Tehran).

Statistical Methods

Comparative statistical analyses were conducted using IBM SPSS Software version 22, with a significance level of less than 5 percent. The Kolmogorov-Smirnov test verified the data's normal distribution. To compare the data between the groups, ANOVA test was used along with Bonferroni's post hoc test. Additionally, the paired t-test was employed to assess changes within the groups.

3. Results

Table 1 presents the variations in anthropometric measurements resulting from TRX, milk thistle supplementation, and the combination of both interventions. Data are expressed as mean and standard deviation.

Based on what was mentioned, to compare the changes between groups of each variable, first the delta of that variable was calculated by the difference between the pre- and post-test numerical values. Then the delta values were compared between the groups using a one-way ANOVA test, and the Bonferroni post hoc test was used to compare each pair of groups. Based on the findings of the ANCOVA test, a significant difference was observed in each of all cardiovascular risk factors of the study groups ($p < 0.05$).

Table 1: Intra-group variations of anthropometric indices in the pre-test and post-test conditions in the studied groups

Group	Time	Control	Exercise	Supplement	Combine
Weight (kg)	Pre-test	91.32 ± 4.26	92.03 ± 5.23	91.14 ± 6.26	92.15 ± 6.26
	Post-test	91.21 ± 6.45	90.62 ± 6.32	89.63 ± 6.52	88.16 ± 6.39
	Sig	0.362	0.036	0.024	0.009
AC (cm)	Pre-test	114 ± 6	115 ± 4	114 ± 11	115 ± 9
	Post-test	115 ± 7	111 ± 6	111 ± 8	110 ± 4
	Sig	0.458	0.039	0.032	0.007
HC (cm)	Pre-test	111 ± 4	115 ± 5	112 ± 9	112 ± 7
	Post-test	112 ± 7	110 ± 36	110 ± 6	108 ± 9
	Sig	0.536	0.009	0.019	0.006
BMI (kg/m²)	Pre-test	30.16 ± 2.14	30.05 ± 2.25	30.10 ± 2.56	30.79 ± 3.15
	Post-test	30.13 ± 3.21	29.59 ± 3.16	29.60 ± 3.41	29.46 ± 3.42
	Sig	0.535	0.007	0.019	0.003
Body fat (%)	Pre-test	35.36 ± 5.44	36.33 ± 5.55	35.53 ± 5.59	36.57 ± 5.63
	Post-test	35.24 ± 4.16	33.29 ± 5.45	33.62 ± 5.28	30.27 ± 6.54
	Sig	0.169	0.025	0.033	0.001
- AC: abdominal circumference, HC: hip circumference, BMI: body mass index					
- Data compared by paired t-test ($p < 0.05$)					

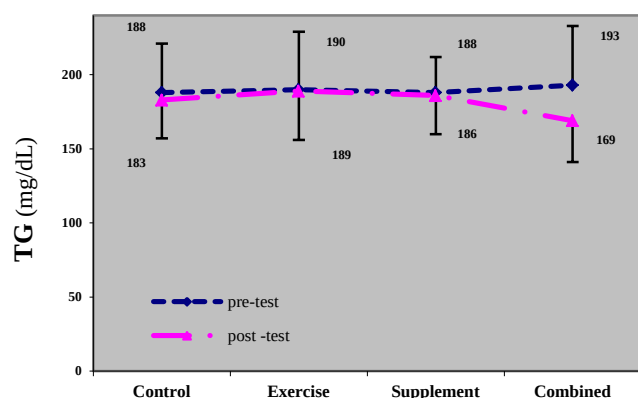


Fig 1: Pattern of triglyceride changes in the study groups

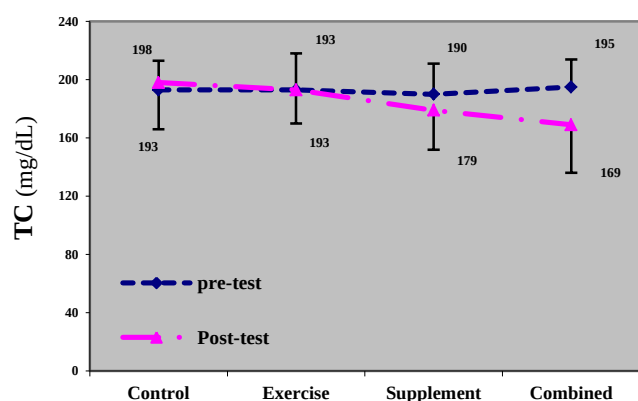


Fig 2: Pattern of TC changes in the study groups

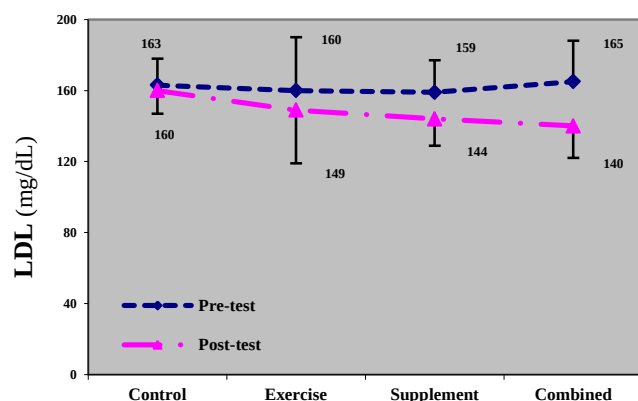


Fig 3: Pattern of LDL changes in the study groups

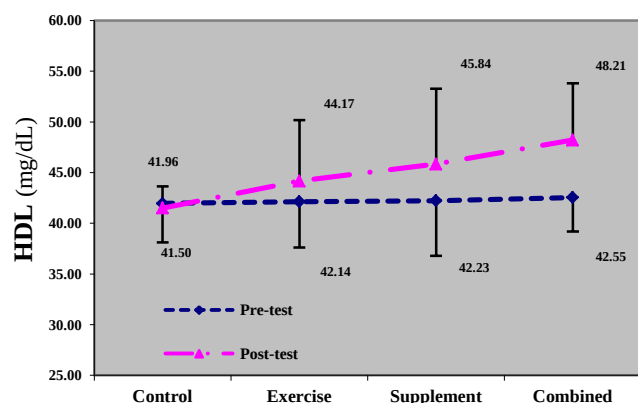


Fig 4: Pattern of HDL changes in the study groups

Based on the Bonferroni post hoc test, a significant difference in TG levels was observed in control group with another groups (exercise, $p = 0.025$; supplement, $p = 0.019$; combined, $p = 0.011$). In other words, all 3 interventions of TRX, milk thistle supplementation, and their combination together led to a significant decrease in TG compared to the control group (Fig 1). However, only milk thistle supplementation was observed to significantly reduce TC compared to the control group ($p = 0.012$) and the difference between the other groups was not significant ($p > 0.05$) (Fig 2). On the other hand, LDL levels in all 3 intervention groups decreased significantly compared to the control group (exercise, $p = 0.003$; supplement, $p = 0.011$; combined, $p = 0.001$). However, there was no significant difference between the other groups ($p > 0.05$) (Fig 3). Also, HDL levels in all 3 intervention groups increased significantly compared to the control group (exercise, $p = 0.023$; supplement, $p = 0.011$; combined, $p = 0.019$) (Fig 3).

4. Discussion

Improvement of cardiovascular risk factors following TRX, Milk thistle consumption, and their combination are the main findings of the present study. Several studies have reported on the response or adaptation of hormonal and metabolic components to different training methods in different populations. The study findings support the beneficial effects of TRX training and milk thistle supplementation on TG, TC, LDL, and HDL as cardiovascular risk factors. However, conflicting evidence on the effect of exercise training, nutritional supplements, or their combination on metabolic indices or cardiovascular risk factors has been observed in other previous studies. For example, Januzek et al, (2014) reported no change in lipid profile indices or cardiovascular risk factors (TG, TC, LDL, HDL) but a decrease in CRP following 12 weeks of aerobic training in the form of treadmill running (14). Bouchonville et al, (2013) also reported no change in triglycerides, adiponectin, and insulin resistance following 12 months of aerobic exercise in obese adults (15). In another study conducted by Yousefipour et al, (2015), 8 weeks of aerobic exercise were associated with no change in HDL and cholesterol compared to the control group (16).

On the other hand, in confirmation of the findings of the present study, Rassil et al. (2013) also reported a significant increase in HDL along with a decrease in TG, TC, LDL and insulin resistance in response to 4 weeks of moderate and vigorous intensity interval training in obese men (17). Tan et al. (2016) also reported a significant decrease in glucose, triglycerides and body fat mass along with an increase in lipoprotein lipase activity following 10 weeks of aerobic training in overweight women (18). In the study of Stavropoulos et al. (2013), a significant decrease in triglycerides, cholesterol and TC/HDL ratio along with an increase in VO₂max and HDL was observed following 3 and 6 months of aerobic and resistance training in cardiovascular patients (19).

On the other hand, in a study by Baluchnejad et al. (2009), 8 weeks of milk thistle supplement consumption at a daily dose of 100 mg per kilogram of body weight led to a decrease in triglyceride, cholesterol, and LDL levels and a significant increase in HDL in diabetic rats (20). In a study by Somogyi et al. (1989), 4 months of milk thistle seed extract consumption at a daily dose of 3 tablets of 200 mg led to a significant decrease in triglyceride and LDL in diabetic patients with high levels of cardiovascular risk factors (21).

This evidence supports the independent effects of both TRX training and milk thistle consumption on cardiovascular risk factors in hypertensive individuals. However, the simultaneous effect of TRX training and milk thistle consumption on cardiovascular risk factors in men with metabolic syndrome has not been reported. However, the findings of the present study revealed that although cardiovascular risk factors improve in response to both TRX training and milk thistle supplementation, their simultaneous application or the combination of TRX training and milk thistle supplementation has more beneficial effects in improving these variables than the application of either alone. It is possible that TRX training provides a suitable platform for the effectiveness of milk thistle on cardiovascular risk factors. Silymarin as milk thistle extract recognized as a potent antioxidant, is believed to safeguard liver cells as well as other cellular structures within the body and brain. Numerous animal studies have demonstrated that the antioxidant properties of

silybin contribute to the protection of skin from photocarcinogenesis and shield renal tissues from nephrotoxicity induced by cisplatin. Additionally, research involving animal models has indicated that silybin exhibits hypolipidemic effects (22). Treatment with milk thistle significantly decreased both serum and hepatic total cholesterol, triglycerides, VLDL-C, LDL-C and increased HDL-C (23). Also, in another study, the daily consumption of 150 milk thistle seed extract, 2 times a day for 2 months, led to a decrease in cholesterol and an increase in HDL in patients with non-alcoholic fatty liver disease (24). Despite the aforementioned evidence, although the evaluation of changes in cardiovascular risk factors in response to Milk thistle consumption during TRX in hypertensive men is one of the strengths of the study, the cardiovascular effectiveness of these interventions cannot be relied on by measuring these variables alone. This is because numerous biochemical markers such as oxidant and antioxidant components, nitric oxide, inflammatory and anti-inflammatory cytokines are effective in cardiovascular function, especially in patients, and the lack of their measurement is a limitation of this study. Based on these limitations, measurement of these markers by changing the supplement dosage or exercise period is recommended in future studies.

5. Conclusion

Milk thistle supplementation and TRX, both independently and in combination, lead to improvement of cardiovascular risk factors in hypertensive men. Therefore, the application of these interventions, even independently, with the approach of improving cardiac function, is recommended for these patients. However, given the lack of difference in some variables (LDL, HDL) in the combined group compared to the independent groups, it is recommended to conduct such studies with a longer training period and changes in the Milk thistle dosage in order to evaluate the effectiveness of these interventions in patients.

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Authors' contributions

All authors equally contributed to preparing this article (Conceptualization, Project administration, Methodology, Investigation, collecting the data, Writing-Review & Editing).

Conflict of interest

Authors declare that they have no competing interests.

Data availability

Data available on request from the authors

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