ORIGINAL ARTICLE

Effect of Combining Resistance Training and Curcumin Supplementation on liver Enzyme in Inactive Obese and Overweight Females

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Received: 10 March 2017

Accepted: 08 May 2017

Published in July 2017

Abstract

Objective: Despite the prevalence of obesity related liver disease in many countries, there is still no definitive pathway for prevention and treatment. The aim of this study was to determine the effect of combining resistance training and curcumin supplementation on liver enzyme in inactive obese and overweight Females.

Materials and Methods: The study was done in a quasi-experimental trial. In this regard, thirty-one inactive young females (BMI: 28-32 age: 20-35 years) were divided into one of four homogenized groups: curcumin (CUR; n=9); that consumed 80 mg Nano-micelles curcumin/day for 8 weeks and curcumin plus resistance training (50%-80% of 1RM) (RTCUR; n=9) placebo (PL; n=7), resistance training plus placebo (RTPL; n=7). The resistance training was performed three sessions per week for a total of eight weeks.

Results: The results showed that AST (*P*-value:0.004) and ALT (*P*-value:0.005) concentration significantly decreased in RTCUR group. However, findings revealed no significant difference in ALP (*P*-value:0.2), GGT (*P*-value: 0/3) levels in RTCUR group following eight weeks of exercise training.

Conclusion: Findings suggested that ALT and AST, waist-hip ratio, and Body Fat% are improved by simultaneous use of resistance training and curcumin supplementation.

Keywords: Liver enzyme, Curcumin, Resistance training
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Introduction

Liver is an important organ in the body's metabolism and unhealthy life style can damage it (1). The high prevalence of obesity and overweight increase the risk of liver diseases (2). Obesity is a key reason of fatty liver, cancer, diabetes and cardio vascular diseases (3). Fatty liver is a chronic liver disorder. It is associated with fat accumulation in hepatocytes. This disease is silent. It can be going non-alcoholic steatosis and cirrhosis with changes associated with inflammation. Fatty liver is usually associated with increased liver function tests such as Alanine transaminase (ALT), Aspartate transaminase (AST) and Alkaline phosphatase (ALP) (2).

In the early stages of disease, there are many pharmacological and non-pharmacological ways to deal with it. Weight loss through diet and physical activity can be effective with liver metabolism and antioxidant capacity improvement (3,4).

The effect of physical activity on liver enzymes is not the same in all studies. Most studies have confirmed the role of aerobic training in improving liver function (3). But in relation to resistance training, there are many differences of opinion. Some studies showed no significant effect of resistance training on improving liver function (5,6). There are also studies that confirm the positive role of resistance training in improving these enzymes (7-9). The changes in liver enzymes can be affected by volume, intensity and type of exercise. (10).

The oxidative stress plays an important role in the development of liver disease, so taking antioxidant is recommended to prevent liver fibrosis (11).

In recent years, researchers showed great interest in using herbal antioxidant as non-pharmacological treatment (11). Turmeric is used as a spice in Asian countries and it is the family of ginger (zingiberaceae) with the scientific name of curcuma longa. It's English name is Turmeric (12). Curcumin in turmeric has anti-inflammatory, anti-cancer, anti-bacterial and anti-diabetic activities. Also it is a potent inhibitor in reaction of antioxidant enzymes such as: lipoxygenase, cylooxgenase (13,14).

The antioxidant properties of turmeric improve liver and kidney function in diabetic rats. Curcumin as the basic ingredient of turmeric has the highest therapeutic effects compared to other compounds (12). Taking curcumin can reduce liver enzymes (15). Regular aerobic exercise reduces adipose tissue and improvement liver function. Resistance training may be an alternative therapy, but there is limited available evidence. The present study examined the effect of combining resistance training and curcumin supplementation on liver enzyme in inactive obese and overweight females.

Materials and Methods

Participants

Thirty one inactive obese or overweight women (BMI≥ 25 kg.m-2 aged 20-35 years) volunteered for study. The informed of the research objectives and procedures in a briefing session for all subjects was described and signed the informed consent forms. According the checklist all subjects had to meet the inclusion criteria prior to being included in the study: 1) physical & mental health, 2) non-smokers, 3) no participation in regular physical exercise, 4) consumption no supplements or medications in the past 6 months. The study protocol and methodology approved by the by the ethical approval Graduate Council, Faculty of Physical Education and Sports Science, Islamic Azad University, Tehran Central Branch.

Study design

In this quasi-experimental study, interventions were administered over an 8 weeks period. The subjects were randomly assigned into one of four homogenized groups: curcumin (CUR; n=9), resistance training plus curcumin (RTCUR; n=9), placebo (PL; n=7) and resistance training plus placebo (RTPL; n=7). The groups were matched according to anthropometric characteristics. Accordingly, 18 obese or overweight women (CUR and RTCUR) orally consumed one capsule of curcumin (80 mg Nano-micelles - made in Nano-Sina Exir Tehran-Iran) per day before lunch with a glass of water. The PL and RTPL groups consumed 80 mg of powdered milk in one capsule onetime a day (placebo) before lunch with a glass of water. In addition, each subjects from each group followed a resistance-training program for eight weeks. All subjects were carefully instructed not to change their routine diet plan and physical activity or not to participate in another training program throughout the course of the study. Besides, the 24-hr diet recall questionnaires were used to control and determine nutritional conditions in the first and second blood sampling. The subjects were instructed to follow their routine diet strictly.

Anthropometric measurements

The trained clinical technician conducted all anthropometric measurements, while subjects were without footwear, headgear or heavy clothes. Height (HT) (to nearest 0.1 cm), was taken with stadiometer, weight was measured to the nearest 100 g using an electronic portable scale (Chasmors, UK). Waist (WC) measured at the center between the lower margin of the rib cage and the top of the iliac crest and the hip circumference (HC) was measured at the level of widest part of the hip region (to nearest 0.5 cm). Body mass index (BMI; BW (in kg) / HT (in meter) 2) and waist-hip ratio (WHR) were evaluated. The body composition (BC) device (Zeus 9.9 Plus) assessed the BC changes after an overnight fast. (Table,1)

Resistance training protocol

The subjects underwent supervised resistance training (RT) program for 8 weeks on 3 days per week by exercise physiologist. All the sessions began with a gentle aerobic warm-up period for 10 min and ended with 10 min gentle aerobic recovery. In brief, RT was consisted of a 7 exercises circuit as detailed in item: leg press, knee extension, lateral pull down, seated row, chest press and bicep curl and triceps pushdown. Besides, subjects completed one abdominal workout the abdominal curl. Moreover, 1-2 min of rest between each item and 3-5 min of rest between circuit exercises were given to subjects. In the first week of RT program, subjects performed three sets of 8–12 repetitions at 50% of the estimated1RM (1RM = maximum load that a person can move/lift in a single maximal effort). From week two, intensity of RT program was increased by 5% of 1RM over the study period. Each subject's 1RM was reassessed in week 4 and load training was adjusted accordingly(16).

Nutrition and physical activities control strategies: all subjects were asked to follow their usual diet and avoid extra activities and exercises during the intervention period. In addition, nutritional questionnaire was used to control nutritional status before the blood tests so that subjects were instructed to strictly follow the same diet (17)

First, the subjects were asked not to perform any physical exercise two days before the trial. In an overnight (12-hour) fasted state, a 5 m L blood samples were drawn via vein puncture of an ante cubital vein from each subject at baseline, at 24 hours before starting RT protocol and 24 hours after ending 8-week RT protocol. For biochemical measurements, 5 cc blood was taken from antecubital vein from every subject. The sample was assigned to tubes without anticoagulants. The samples were allowed to clot at room temperature for 10 min.

After coagulation, the samples were centrifuged at 3500 rpm for 10-min, the serum was separated using a sampler. The collected samples were transferred in to micro tubes and stored at -70C° for subsequent analysis. Liver enzyme levels were measured at baseline, at 24 hours before starting RT protocol and 24 hours after end of 8-week RT protocol. Liver enzyme levels were determined using by, parsazom, kits and through the spectrophotometry method.

Statistical model

Prior to statistical comparison, all data sets were examined for normal distribution by a Kolmogorov- Smirnov test. Data were stated as Mean ±SD and analyzed by the two-way analysis of variance (ANOVA) and post-hoc LSD tests using the SPSS statistical software package (SPSS version 16.0 for Windows, SPSS Inc., Chicago, IL, USA).Significance was established at $P<0.05$.

Results

The subjects were randomly assigned into four homogenized groups: curcumin (CUR; age=28.5±6.06, Bw=78.67±7.14), resistance training plus curcumin (RTCUR; age= 26.88 ±6.21, BW= 78.86 ±9.05), placebo (PL; age = 27.28 ± 4.61, BW= 75.22 ±6.22) and resistance training plus placebo (RTPL; age= 22.73± 4.43, BW= 84.03 ±6.42) and other anthropometric characteristics at the start of the study are revealed in Table-1. Prior to the interventions there were no significant differences in age, BW, HT, BMI and BFP among the four groups ($P>0.05$).

The statistical comparisons of liver enzymes before and after interventions were presented in Table3.

In total four groups, the baseline mean was beyond the desirable levels (normal ranges) In comparison with standard values, body fat percentage, fat mass (FM), and WHR decreased in the groups RTCU and RTPL independently of CU and PL groups after 8weeks. In addition, there was a mean increase in fat free mass (FFM) in the groups RTCU, RTPL and, while mean FFM remained unchanged in two other groups

Anthropometric

In percentage terms, after 8-weeks trial, data of this study displayed that BMI from 30.1±2.04 to 29.45±1.84 (2.8%) (P=0.2); body fat% from 35.63±2.92 to 34.68±2.96 (2.7%) (P=0.02), and WHR from 0.84±0.03 to 0.82 ±0.02 (2.3%) (P=0.04) decreased significantly in the RTCUR independently of CUR and PL groups. Furthermore, there was a significant mean increase in BMI in CUR (0.84%) and PL (0.34%) groups; Fat percentage in CUR (2.7%) and PL (1.6%) groups and WHR in PL (1.17) while, mean WHR remained unchanged in RTPL and CUR groups. Generally, RTCUR exposed the biggest decrease in all anthropometric variables comparing with other groups whereas RTPL indicated a decrease in fat percentage and an increase in BW. Moreover, CUR and PL demonstrated a significant increase in anthropometric characteristics. Except for WHR that presented no significant change, other variables revealed largest increase in CUR group. Additionally, the

Table1. Anthropometrics characteristics of all subjects

Variable	CUR (n=9)	RTCUR (n=9)	PL (n=7)	RTPL (n=7)	*P*-value
Age (years)	28.5± 6.04	26.88± 6.21	27.28± 4.61	22.73± 4.43	0.108
HT (cm)	159± 4.81	161± 6.83	161± 5.88	166± 3.7	0.163
BW (kg)	78.67± 7.14	78.86± 9.05	75.22± 6.22	84.03± 6.42	0.173
WHR (m)	0.84± 0.01	0.84± 0.02	0.85± 0.04	0.86± 0.05	0.644
BMI (kg.m^{-2})	30.79± 1.85	30.13± 1.04	28.8± 0.74	30.42± 1.14	0.215
BFP	36.74± 2.25	35.63± 2.91	36.51± 2.80	36.76± 2.51	0.751

Value are mean (± standard deviation), n: number of subjects

Table2. Diet Analysis

Group	Protein	Fat	Carbohydrate	Calorie
RTPL	82.43 ±18.45	64.5962±12.47	244.86± 90.25	1876±373.6
PL	66.12 ±27.89	50.2771±28.82	187.99± 51.51	1458±307.8
RTCUR	99.91 ±60.29	52.3433±27.13	227.76± 67.99	1676±359.9
CUR	78.14 ±24.31	59.6429±22	82.08 ± 31.33	1577±309.8
***P*-value**	0.3	0.6	0.2	0.13

Table3. Liver enzyme pre- post training and supplement interventions. Values are means (± standard deviation).

Varible	CUR (n=9)		RTCUR (n=9)		PL (n=7)		RTPL (n=7)		*P*-value
Liver enzyme	Pre	Post	Pre	Post	Pre	Post	Pre	Post	
Alp (U/L)	105.2±13.2	125.8±2.2	124.5±3.4	125.11±4.2	115.42±2.5	135.8±2.5	113.3±3.1	125.2±3.7	0.2
ALT (U/L)	10.14±1.9	12.42±4.3	14.33±5.25	12.33±4	9.14±2.79	20.14±3.7	12±3.4	12.25±2	0.005
AST (U/L)	20.14±2,47	19.42±5.9	26.11±5.23	20.77±5.5	20±3.9	27.71±6.7	23.26±3.7	21.87±3.7	0.004
GGT (U/L)	22.7±10.2	22.6±5.4	17.6±6	15.4±5. 34	18.6±7.6	21±2.4	11.12±1.7	12.5±3.7	0.3

results of one-way ANOVA exposed significant difference in WHR and Fat% between RTCUR and CUR and PL groups after 8-weeks intervention .In general after intervention, RTCUR group compared to other groups indicated significant reduction in all dependent variables in relation to anthropometric values (BMI, BFP and WHR).

Liver enzyme

Monitoring liver enzyme changes before and after intervention revealed that In relation to ALP levels statistical analysis revealed that time effect (F=12.3, *P*=0.002); between group effect (F=0.17, *P*=0.9) and the effect of the combination of resistance training with curcumin consumption were not significant (F=1.64, *P*=0.20). In addition, the statistical procedure for ALT changes stated that time effect (F=5.65, *P*=0.025); between group effect (F=0.6, *P*=0.62); and RT+CUR (F=5.39, *P*=0.005) were significant. The LSD post hoc test showed a significant difference between the PL group and the three other groups .In addition the study of AST changes disclosed that time effect (F=0.0001, *P*=0.98); between group effect (F=1.037, *P*=0.39) were not significant while the combination of resistance training with curcumin consumption was significant (F=5.53, *P*=0.004). The LSD post hoc test results indicated that a significant difference between the PL group and other groups .The LSD post hoc test showed a significant difference between the PL group and the three other groups. Moreover, the investigation of this study revealed no significant difference between BW, BFP, BMI and WHR.

Discussion

The findings showed that a combination of RT and curcumin supplementation significantly decreased fat percentage and WHR in the subjects. Study has shown that RT can decrease body fat percentage without any changes in abdominal and central obesity (18), and training could decrease fat percentage, WHR and weight. The variations observed in fat percentage despite the lack of change in subjects' diet may relate to increased energy demand by the muscles involved in physical activity while there is still high energy demand after physical activity, which could be considered a negative balance between energy consumption and energy intake (19). In addition, empirical evidence suggests that RT leads to increased muscular mass, muscular strength and resting metabolic rate, which in turn could stimulate subcutaneous and visceral adipose tissue (20).

The present findings showed that, from among the components of liver enzyme combining resistance training and use of curcumin on the density of AST, a significant difference (*P*=0.005) between group PL with other groups observed and increase the amount of enzyme in group P and reduce enzyme happened in the other groups. That this reduction in the group

RTCUR is statistically meaningful after statistical analysis in order to combining resistance training and use of curcumin on density of ALT, a significant difference between group PL and other groups observed (*P*=0.005). The amount of this enzyme in all group except RTCUR (significant decrease) increased. The amount of GGT decreased in RTCUR and CUR and increased in RTPL and P L but this changing was not significant (*P*=0.32).

APL enzyme was associated with non-significant increase (*P*=0.20) in all groups that this increase was in the minimum amount .Change in the liver cells functions as a life line in the body's metabolism and the main part witch engages in metabolic processes can effect on metabolic needs of other devices in the body.

Aspartate aminotransferase enzymes and alanine aminotransferase in particular considered as the most important performance indicators for liver health. The importance of measuring AST enzymes is back to the assessment of myocardial infarction and disorders of the liver cells. Regular physical activities create compatibility with different mechanisms of the body.

The impact of polls of job training is very different, because it is influenced by life style, duration, type and gender and also the basic level of health and studies in this respect have different responses. Some studies reported the influence resistance training and aerobic exercise on liver enzymes equally (10-21). Manal (2014), reported three months of aerobic exercise on liver enzymes and the positive effects of exercises on liver functions (4). Nazarali, has reported positive impact of exercise, during the study the effect of aerobic exercise and consumption of curcumin on liver enzymes and CRP. Eight-week swimming training leads to lower liver enzymes in healthy women (22). In our evolution, some researchers presented different answers from their researches. There is not clear mechanism through witch resistance training can have an impact on improving liver function: But, probably changes in energe balance, blood fat, lipid oxidation and insulin sensitivity can influence on liver fat. In reviewing other mechanisms in their study showed during the eight- week resistance exercise on nonalcoholic fatty liver, states that reduce liver fat, abdominal fat and increased insulin sensitivity occurs with no change in weight (7). Insulin sensitivity plays on important role in hemostasis of liver fat. Exercise can increase GLUT4's expression and insulin receptor and thereby enhance insulin sensitivity (21). However, now this mechanism has not been studied, but possible response to this exercise can be like this. Tools of gathering TG and followed by the development of oxidative pressure and cytokines witch mediate inflammation and cirrhosis of the liver.

Perseghin, 2007, in the studies have shown that, higher levels of physical activity, is directly related to the low intra-hepatic fat (23). Reported that, in general, physical activity increases whole body fat oxidation in adipose tissue, muscle tissue and liver tissue that leading to reduced fatty acid in circulation (24). During the surrey conducted in this study, triglycerides and VLDL as a result of combining resistance training with the use of curcumin, has fallen and perhaps, we can attribute this enzyme changes to reduce blood fat also physical activity helps to reduce abdominal fat and visceral (The two main fatty acids witch are released in the plasma and they are available to get through the liver) (25). Some research suggested that resistance training reduces body fat percentage without changing in abdominal obesity, and central (18). Or reducing fat percentage, WHR, weight accrues with exercise (26). The researchers also believe that, exercise may improve indices of inflammatory and antioxidant capacity (3).

On the other hand, studies have shown that turmeric is anti-cirrhosis and it's protective role on the liver due to its antioxidant effect. It is observed that, the effects of turmeric dye plays and important role to prevent liver dys function, maintenance of plasma lipid homeostasis and CVD risk reduction (27). In other words, curcumin has protective effect on the liver and fat reduction (23). probably, these changes in body fat percentage, due to the lack of changing diet can be due to the increased energy demands of the muscle are involved in physical activity, and after the activity, demand is still high. And negative balance between energy expenditure and energy intake, due to this fact.

Also, evidence suggests that resistance exercises increase muscle mass, muscle strength and the amount of resting metabolic rate (11-14). And as a result, ideally stimulates the subcutaneous fat issue, visceral and fat loss. Perhaps, these changes improving liver function and be effective (2-13).

Conclusions

In this study, only obese people who have the tendency have been examined. Most previous research related to diabetic patients or patients with fatty liver.

Different subjects, intensity, type and duration of training can show different physiological responses but, can be expressed in this research, practice and taking curcumin can play a preventive role against liver damage.

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