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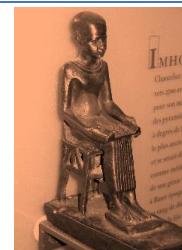


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## Original Article

# Effect of Baduanjin Exercise on Liver Enzymes in Non-Alcoholic Fatty Liver Disease Patients

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## Abstract

### Article information

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**Background:** Baduanjin exercise [BE] is an old Chinese mind-body training that was originally used in China approximately 1,000 years ago. It has been used in the treatment of cardiovascular risk indicators, including non-alcoholic fatty liver disease [NAFLD], which is mainly treated by exercise with or without caloric restriction.

**Aim of the study:** The aim was to examine the effects of adding BE to the caloric restriction programme on liver enzymes in patients with NAFLD.

**Patients and Methods:** From both sexes, sixty patients with NAFLD participated in this study. They were aged between 50 and 60 years old and had a body mass index [BMI] ranging from 30 to 34.9 kg/m<sup>2</sup>. Patients were randomly assigned into two groups; Study and control groups. The study group [n=30] received a 40-minute Baduanjin exercise daily plus a hypocaloric diet. The control group [n=30] received the hypocaloric diet alone. The patients' BMI, serum triglycerides [TG], waist circumference [WC], liver enzymes comprising alanine transaminase [ALT] and aspartate transaminase [AST], six-minute walk test [6MWT], and The Short Form 36 health survey [SF36] [physical and mental summaries] were assessed in both groups two times pre-study and after eight weeks at the end of the study.

**Results:** A significant improvement in BMI, TG, WC, ALT, AST, 6MWT, and SF36 [physical and mental summaries] was documented within both groups, but the better level of improvement was detected in the study group but with a significant improvement in favor of study group.

**Conclusion:** This trial suggests that adding 8-week BE to caloric restriction programme played an important role in improving weight loss, abdominal obesity, liver enzymes, physical capacity, triglycerides, and quality of life in NAFLD patients.

**Keywords:** Baduanjin exercise; Caloric Restriction; Liver Enzymes; Triglycerides; Non-alcoholic Fatty Liver Disease.



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## INTRODUCTION

Non-alcoholic fatty liver disease [NAFLD] is defined by excess fat deposition in more than 5% of hepatocytes in non-alcoholic individuals. The prevalence of NAFLD has risen to around 800 million cases worldwide. It is present in one-third of the Middle East and South America and was reported to be as high as 13.5% in Africa. Currently, 30% of the general population has it. Besides the risk of developing metabolic syndrome and low quality of life [QoL], NAFLD is thought to be a risk indicator for developing cirrhosis, liver fibrosis, and ultimately hepatic cancer. Liver transplantation is the only intervention that can reverse the disease's progression to decompensated cirrhosis [1]. As there are currently no FDA-approved medications for NAFLD, new guidelines support lifestyle modifications as viable treatments. These interventions include eating a healthy diet and engaging in periodic physical activities [2] such as Baduanjin exercise [3].

Baduanjin exercise [BE] is a type of mind-body training that was originally used in China approximately 1,000 years ago. There are just eight basic forms in Baduanjin, and they are all connected to one another by smooth transitions. A low demand for physical ability and training space makes it a home-based training for promoting physical health, even for older people with imbalance, stroke, Parkinson's disease, knee osteoarthritis, diseases of the patellar extremity, etc. [3].

It is documented that people who are more susceptible to conditions like cardiovascular illness and metabolic syndrome may benefit physiologically from exercise training [4-13]. Regular sessions of BE, one of the widespread aerobic exercises, are recommended in the treatment of cardiovascular risk factors for their blood pressure management, musculo-skeletal balancing, lipid metabolism, cardiorespiratory function, and mental well-being [14].

Mind-body training can improve insulin resistance and obesity by diminishing circulating free fatty acids, oxidative stress, and inflammation. These changes can all lessen cardiovascular risks. Mind-body training also increases low-density lipoprotein [LDL], triglycerides [TG], high-density lipoprotein [HDL], and glucose utilisation in addition to lowering blood glucose levels. Mind-body training has the potential to improve blood pressure by modifying markers of sympathetic and parasympathetic nervous system activities, enhancing sensitivity to stress responses, reducing arterial tension, and decreasing peripheral resistance [15]. Exercise in Baduanjin has the potential to lower body mass index [BMI], serum triglyceride levels, regulate systemic hypertension, and manage elevated levels of oxidative stress and inflammatory mediators. These results could explain why Baduanjin exercise may be biologically effective for several chronic health disorders [16]. In both healthy individuals and patients, Baduanjin can clearly raise plasma concentrations of high-density lipoproteins [HDL] and lower concentrations of triglycerides [TG], total cholesterol [TC], and low-density

lipoproteins [LDL]. Baduanjin can enhance lipid synthesis by inhibiting the synthesis of cholesterol in one or more routes, such as those that promote TG transport and breakdown, increase TC scavenger ability, and increase TC ability to transport and reduce acetyl coenzyme A [17].

In addition, BE is a safe practise with low to moderate intensity when compared to other types of aerobic or resistance exercise. There have been no reports of discomfort, soreness in the muscles, exhaustion, dizziness, or sports injuries related to the Baduanjin practise. As a result, it is advised as an appropriate strategy for promoting health among the middle-aged and older residents of the community [18].

Although BE is important for the rehabilitation of various diseases, no randomized controlled trial has been done to explore the efficacy of BE on liver enzymes in NAFLD patients. So, this study aimed to investigate this domain.

## PATIENTS AND METHODS

**Design:** A randomized controlled trial.

**Settings:** Patients were allocated from the internal medicine outpatient clinic, Basyoun Central Hospital, EL-Gharbia Governorate.

**Ethics:** Before starting this study, prior informed consent of all the subjects was obtained and a clearance was gained from the institutional ethical committee of the Faculty of Physical Therapy, Cairo University [P.T/REC/012/005196]. Helsinki guidelines were followed.

**Inclusion criteria:** Patients [n=60 from both sexes] with NAFLD were included [the treating physician confirmed the diagnosis of NAFLD, determined via routine ultrasonography. Patients' body mass index [BMI] ranged from 30-34.9 Kg/m<sup>2</sup>. The ages of patients ranged from 50-60 years old.

**Exclusion criteria:** The study's authors eliminated/excluded anyone with musculoskeletal disorders, respiratory complaints, cardiac diseases, renal dysfunctions, autoimmune problems, psychiatric or mental disorders, hypertension, diabetes, other hepatic disorders such as hepatic cancer and hepatitis, neurological disorders, patients with malignancies, patients with smoking or alcohol abuse, or a peripheral vascular disease. NAFLD patients who followed exercise, diet protocols or any complementary therapies within the last 6 months preceding this study were excluded.

**Randomization:** A computerized block list was used to randomly assign the NAFLD patients into two groups: The study group and the control group. A planned enrollment of 60 participants, 30 per group were randomly assigned. Below, a computer algorithm written in SAS® [Cary, NC] which presented for performing a block randomization with randomly selected block sizes of 4, 6 and 8. The study group [n=30]

received a 40-minute BE daily plus a hypocaloric diet for eight weeks. The control group [n=30] received the hypocaloric diet only for eight weeks [Figure 1].

**Programme of BE:** It is common practise to perform the eight slow motions that comprise a Baduanjin exercise symmetrically, focusing on deep, rhythmic breathing and cultivating a meditative mood [9].

The following exercises are part of these exercises: "the patient raises his hands and places his palms upwards," "Patient use both left and right hands to shoot," "patient raising one arm to control the spleen and stomach's functioning," "patient examine the past to avoid illness and stress," "patient lower the body and swing his head to release tension," "To strengthen the kidneys, patient run his hands down his legs and back, putting his fingertips on his feet," "The patient may raise or lower his heels to increase strength," yet "the patient can push his fists and glare his eyes" [9].

**Hypocaloric diet:** A relatively low-fat, calorie-restricted diet with a suggested macronutrient balance of 55% carbohydrates, 15% protein, and 30% fat was adhered to by all participants in both groups [6,8,11]. Utilising the Harris–Benedict equation, a technique for estimating a person's basal metabolic rate [BMR], calorie prescriptions were estimated [19].

- BMR for Men [kcal/day] =  $[9.99 \times \text{weigh in Kg}] + [6.25 \times \text{height in cm}] - [4.92 \times \text{age in years}] + 5$ .
- BMR for women [kcal/day] =  $[9.99 \times \text{weigh in Kg}] + [6.25 \times \text{height in cm}] - [4.92 \times \text{age in years}] - 161$ .

**Outcomes:** Patients' BMI, serum triglycerides [TG], waist circumference [WC], liver enzymes comprising alanine transaminase [ALT] and aspartate transaminase [AST], Six-Minute Walk Test [6MWT], and The Short Form 36 health survey [SF36] [physical and mental summaries] were assessed in both groups.

**Blinding:** The assessors of BMI, TG, WC, liver enzymes [ALT and AST], 6MWT, and SF3 [physical and mental summaries] in groups of NAFLD did not know the details of the hypocaloric diet or BE.

**Statistical analysis:** The collected data were analyzed statistically test of normality; results are presented as mean  $\pm$  standard deviation [SD]. The difference was calculated as follows: - Difference = pre-assessment – post-assessment. The Shapiro-Wilk test was used to verify that the data were normal. To evaluate the homogeneity between groups, Levene's test for the homogeneity of variances was utilized. There was homogeneity of variance and a normal distribution of the data. To compare the subject characteristics [age] between groups, an unpaired t test was used. To compare the subject characteristics [BMI and WC] between groups, a mixed MANOVA was used. A chi squared test was utilized to compare the distribution of

sexes. To evaluate the improvement of outcomes both within and across/between groups, a mixed MANOVA was applied. All statistical tests were conducted with a significance level of  $p < 0.05$ .

## RESULTS

**Table [1]** did not show between-group significant difference between participants' main characteristics [sex distribution, age, BMI, and WC].

**Table [2]** did not show between-group pre-treatment significant difference in TG, liver enzymes [ALT and AST], 6MWT, and SF3 [physical and mental summaries]. A significant improvement in BMI, TG, WC, ALT, AST, 6MWT, and SF36 [physical and mental summaries] was documented within both groups, but the better level of improvement was detected in the study group. Post-treatment between-group comparison of all outcomes indicated a significant improvement in the direction of the study group.

## DISCUSSION

Physical exercise is an effective way to achieve weight loss in obese subjects. However, many kinds of physical exercise are intense or monotonous, making it difficult for people to maintain exercise. Moreover, patients with obesity cannot do too much intensive and strenuous exercise, or it may induce severe exercise-induced muscle injury. Therefore, the exercise intensity and duration for obese patients must be carefully selected [20]. In cardiovascular and metabolic diseases, research has shown that mind-body exercise can improve some metabolic syndrome associated risks, such as dyslipidemia, hypertension, hyperglycemia, and obesity. Regular mind-body exercises can improve insulin tolerance and responses in peripheral target tissues, decrease body fat, improve circulation to the skeletal muscles, increase glucose utilization, reduce insulin resistance, and promote glucose uptake and metabolism in skeletal muscles, thereby helping to improve metabolic syndrome [21].

Besides Baduanjin exercise is more suitable for obese patients with endocrine and digestive system diseases, Qigong is practised by Chinese people to improve health, correct dysfunctions of body organs, prevent disease and prolong life in the context of a wide range of conditions [22]. this may explain the improved liver enzymes after Baduanjin exercise in NAFLD.

*Regarding the improved liver enzymes*, the liver's functions include blood storage and maintaining a free flow of qi [vital energy] throughout all the organs. The liver's function is affected by poor lifestyle habits; Such as lack of exercise. Due to hepatic fat accumulation, liver qi stagnation is a typical feature in NAFLD. Besides Baduanjin exercise is more suitable for obese individuals with endocrine and gastrointestinal problems, Qigong is practised by Chinese people to enhance

health, repair body organ dysfunctions, prevent disease, and prolong life in the context of various situations [22]; This may explain the improved liver enzymes after the Baduanjin exercise in NAFLD.

Regarding the improved TG, research indicates that Baduanjin exercise improves TG deposition and storage via the significant reduction in inflammatory markers [23], which are highly presented with excess obesity-related lipids [12].

Baduanjin is an aerobic type of exercise that is safe and reliable since its intensity and sequence of exercise conform to the laws of human kinematics. The characteristics of the Baduanjin exercise are embodied in the aspects of tenderness, the combination of movement and stillness, the integration of

spirits and shapes, and the existence of qi. Long-term Baduanjin practise lowers body fat percentage, promotes muscular growth, accelerates fat oxidation, and prevents fat deposition. Consequently, Baduanjin exercise can change physical capacity and body type indicators, such as BMI and weight [24].

Regarding the improved quality of life, Traditional Chinese exercise [TCE] is a therapeutic aerobic physical and mental exercise that has been used to enhance mental and physical health, hence improving obese people's quality of life. Also, obesity is often associated with lipoprotein atherogenicity, hyperglycemia, hypertension, and hyperlipidemia, TCE can reduce these indicators while controlling and treating obesity; resolving these chronic issues also enhances patients' quality of life [25].

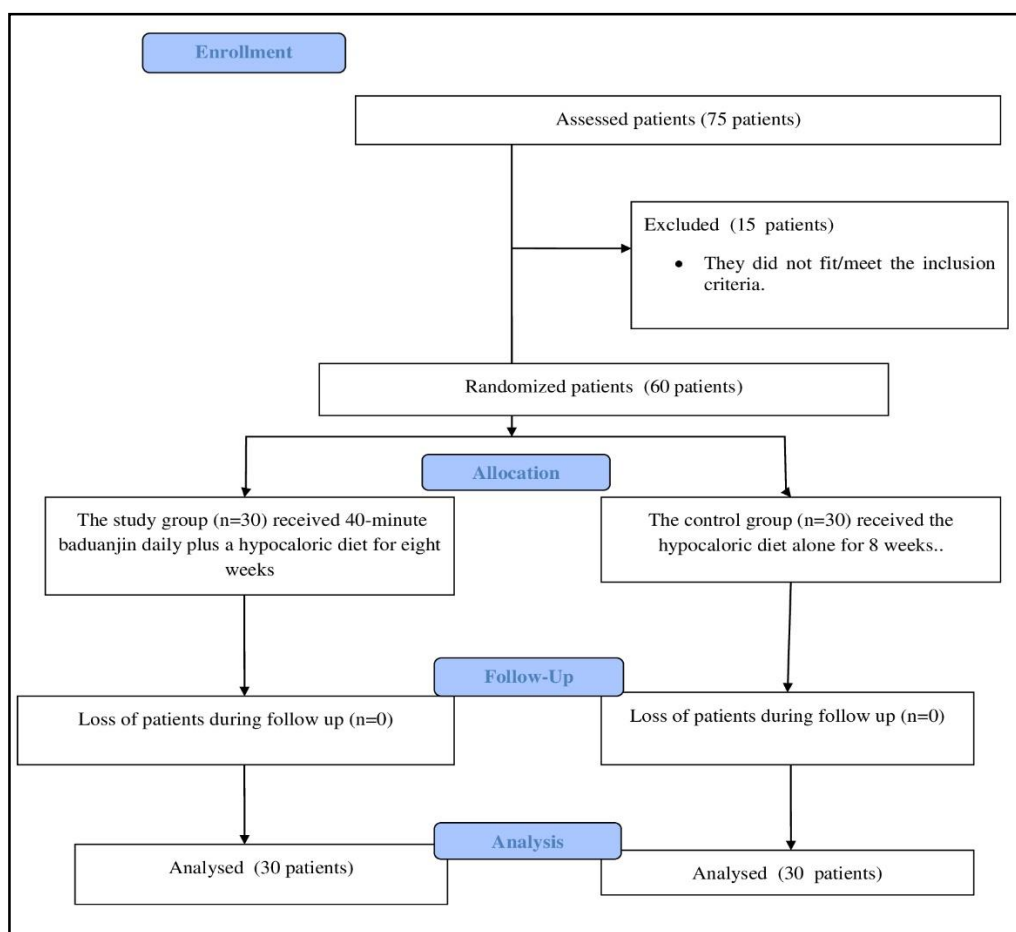


Figure [1]: Flow Chart of the study participants

Table [1]: The data [basic/demographic] before initiating the assigned interventions for NAFLD.

Data	Group of Baduanjin exercise plus hypocaloric diet	Hypocaloric diet group	P value
Age [years]	55.20±3.26	55.66±3.21	0.584
Body mass index [kg/m <sup>2</sup> ]	32.24±1.59	32.80±1.43	0.157
Waist circumference [cm]	105.60±9.99	108.50±11.90	0.311
Sex distribution	14 women:16 men	17 women:13 men	0.438

All data are expressed as mean±SD; Sex distribution is tested via Chi square test. NAFLD: Non-alcoholic fatty liver disease; All p values are non-significant.

**Table [2]:** Outcomes of NAFLD patients.

Outcomes		Group of Baduanjin exercise plus hypocaloric diet	Hypocaloric diet group	P value [between NAFLD groups]
Body mass index [Kg/m <sup>2</sup> ]	Before the trial	32.24±1.59	32.80±1.43	<b>0.157</b>
	After the trial	30.27±1.53	31.70±1.41	<b>&lt;0.001*</b>
	P value [within NAFLD groups]	<0.001*	<0.001*	
Waist circumference [cm]	Before the trial	105.60±9.99	108.50±11.90	<b>0.311</b>
	After the trial	95.40±9.90	103.56±12.16	<b>0.006*</b>
	P value [within NAFLD groups]	<0.001*	<0.001*	
Alanine transaminase [U/L]	Before the trial	26.50±4.80	28.30±3.95	<b>0.119</b>
	After the trial	17.36±4.24	23.46±4.02	<b>&lt;0.001*</b>
	P value [within NAFLD groups]	<0.001*	<0.001*	
Aspartate transaminase [U/L]	Before the trial	36.50±5.52	39.20±7.39	<b>0.115</b>
	After the trial	26.83±5.27	34.33±7.35	<b>&lt;0.001*</b>
	P value [within NAFLD groups]	<0.001*	<0.001*	
Triglycerides [mg/dl]	Before the trial	143.53±21.89	151.40±19.17	<b>0.144</b>
	After the trial	118.93±20.61	136.80±19.25	<b>0.001*</b>
	P value [within NAFLD groups]	<0.001*	<0.001*	
Six-Minute Walk Test [meter]	Before the trial	551.76±70.75	531.90±50.49	<b>0.215</b>
	After the trial	619.63±71.37	573.86±48.80	<b>0.005*</b>
	P value [within NAFLD groups]	<0.001*	<0.001*	
Summary of physical components of SF36	Before the trial	46.40±9.03	42.83±9.68	<b>0.146</b>
	After the trial	56.16±8.69	49.10±10.34	<b>0.006*</b>
	P value [within NAFLD groups]	<0.001*	<0.001*	
Summary of mental components of SF36	Before the trial	59.50±12.36	55.70±11.29	<b>0.219</b>
	After the trial	71.06±13.05	61.36±11.08	<b>0.003*</b>
	P value [within NAFLD groups]	<0.001*	<0.001*	

SF 36: Short Form 36; NAFLD: Non-alcoholic fatty liver disease; \*: Fatty liver patients' P value is significant [P < 0.05].

Regarding the improvement in the enzymes of the liver in the studied NAFLD patients, the presented trial was the first one utilising Baduanjin exercise as a mind-body exercise in those patients. Baduanjin exercise is part of low- to moderate-intensity aerobic exercises and similar to their health effects [26], as reported by an Egyptian study published in 2020. This study showed that the BMI, TG, ALT, and AST showed greater improvement after adding 8-week moderate intensity aerobic exercise to the hypocaloric diet in university students of NAFLD [27]. Consistent with the results of this clinical trial, moderate-intensity exercise conducted for eight weeks significantly improved body weight, health related QoL, and emotional aspects related to NAFLD in middle-aged obese Egyptian women [28]. Consistent with the exhibited results, lipid profile, WC, weight, ALT, and AST were significantly improved after 8-week lifestyle changes [low calorie diet and moderate aerobic exercise] in NAFLD patients [29].

In agreement with the presented findings, a recent study published in 2023. This study divided 60 metabolic syndrome patients into the study group [n = 30 patients who received 12-week Baduanjin exercise plus medication] or the control group [n=30 patients who received their medications only]. The study group only showed a significant improvement in TG, WC, and physical and mental summaries of the short form of quality of life [9]. The significantly improved 6MWT results of schizophrenic patients who aged > 40 years and followed 60-min Baduanjin exercise three times weekly for 12 weeks [30] agreed with the 6MWT results of this trial's patients.

Lined with the presented results, overweight individuals with drug addiction and engaged in an 8-week Baduanjin exercise programme combined with a hypo-caloric diet showed a significant improvement in their BMI, WC, TG, body weight, and quality of life [31].

**Limitations:** Tracking long-term follow-up to the outcomes of the trial was a limitation of performed assessments that must be considered in future trials.

**Conclusion:** This trial suggests that adding 8-week BE to the caloric restriction programme played an important role in improving weight loss, abdominal obesity, liver enzymes, physical capacity, triglycerides, and quality of life in NAFLD patients.

**Conflict of Interest and financial disclosure:** None

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