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Biochemical changes after a qigong program: Lipids, serum enzymes, urea, and creatinine in healthy subjects

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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Summary

Background: The aim of the present study was to analyze the effects of a qigong training program on blood biochemical parameters.

Material/Methods: Twenty-nine healthy subjects participated in the study of whom 16 were randomly assigned to the experimental group and 13 to the control. The experimental subjects underwent daily qigong training for one month. Blood samples for the quantification of biochemical parameters (total cholesterol, HDL, LDL, triglycerides, phospholipids, GOT, GPT, GGT, urea, creatinine) were taken before and after the training program. As statistical analysis, ANCOVA was performed.

Results: Statistically significant differences were found showing that the experimental group had lower serum levels of GOT (glutamic-oxaloacetic transaminase), GPT (glutamic-pyruvic transaminase), and urea and that there was a trend towards significance in GGT (gamma-glutamyltransferase).

Conclusions: This study demonstrates that after practicing qigong for the short period of one month, noteworthy changes in several blood biochemical parameters were induced. While it is tempting to speculate on the relevance and implications of these biochemical variations, further investigation is needed to elucidate the scope of these findings.

key words: **biochemical parameters • meditation • psychosomatic • qigong • stress**

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Background

Qigong is an ancient Chinese form of health maintenance dating back thousands of years which is part of traditional Chinese medicine [1]. Practice of qigong, of which there are many different systems, typically includes mind, body, and breath training [2,3]. Numerous physical as well as mental benefits have been classically ascribed to these methods. Modern scientific research has revealed that qigong can exert beneficial effects on a great number of different medical conditions, including arthritis, hypertension, chronic pain, fibromyalgia, infectious diseases, and even cancer, among others [4–8]. It has also shown anxiolytic and antidepressive efficacy [9,10]. Consequently, qigong has been considered a viable treatment option for long-term health. Although all eastern psychosomatic methods share many common features, qigong has some particular traits which differentiate it from other similar practices, such as yoga, whereby qigong generally entails a more dynamic approach than other meditative traditions [11].

Cardiovascular disease represents a major health problem of western society, counting as one of the main causes of death. In this respect, a large number of investigations have consistently linked high blood lipid concentrations to the development of coronary heart disease. In fact, an increase in the mortality risk from cardiovascular disease has been found to be associated with elevated concentrations of triglycerides, total cholesterol, and low-density lipoprotein (LDL) and to low concentrations of high-density lipoprotein (HDL) [12–14].

On the other hand, the important implications of stress-generating situations on changes in blood lipid levels have been widely documented [12–18]. In this regard, Stoney et al. [14] recently reviewed different studies indicating the importance of psychosocial stressors on increased triglyceride and cholesterol levels in humans. Psychological stress has therefore been reported to cause augmentation of the concentrations of total cholesterol, LDL, and triglycerides in healthy individuals [19] and in those with a greater risk of suffering from cardiovascular diseases [15].

Apart from its relationship with blood lipid levels, cardiovascular risk has also been related to specific serum enzymes [20–22] and renal function parameters [23–25]. The serum enzymes GOT (glutamic-oxaloacetic transaminase), GPT (glutamic-pyruvic transaminase), and GGT (gamma-glutamyltransferase) are often part of the blood tests used to assess hepatic function. Increased values of these biochemical parameters are typically associated with liver pathologies; however, they do not specifically measure hepatocyte function, but rather hepatocelullar damage [26–28]. Similarly, serum levels of urea and creatinine are generally considered to be indicators of renal function, although these measures may also be altered in liver [29,30] and muscle disease [31], respectively. Interestingly, serum levels of enzymes and urea, aside from pathological conditions, may be modulated by behavior. In this respect, physical exercise has been reported to cause an increase in serum enzymes GOT, GPT, GGT [32–35], and urea levels [36–39].

Since psychological factors can certainly influence biochemical measures, a behavioral intervention may be a very interesting and effective tool to modulate these biological variables favorably. As a matter of fact, there is scientific evidence confirming that a reduction of stress through different types of behavioral or psychosocial interventions can decrease the concentrations of several biochemical parameters of clinical interest and help diminish the risk of cardiovascular disease [16,40,41]. In particular, the behavioral approach has been reported to be effective in reducing blood lipids, especially high cholesterol levels [42–44].

Given the potential clinical implications of the aforementioned psychobiological approach, in recent years considerable interest has been directed towards examining the effects that various ancient eastern psychosomatic techniques can exert on psychobiological parameters of relevance to physical and mental health [1,11,45–56]. Thus traditional oriental methods such as qigong, yoga, and various specific forms of meditation have been studied for their potential clinical use, particularly for their positive effect on the cardiovascular system. In this sense, decreases in blood pressure [47,55–63], heart rate [63,64], and cardiovascular reactivity [58] have been reported in subjects who practiced meditation. Various forms of meditation have also been found to be effective in reducing stress symptoms in subjects with diverse physical and psychological pathologies [65,66], including cancer patients [67–70].

Although less studied than meditation as such, yoga has also been said to be useful from a clinical standpoint. Thus yoga has been reported to reduce cardiovascular risk by inducing a wide variety of favorable biological effects, ranging from biochemical to direct cardiovascular changes [71–76]. Likewise, the therapeutic profile of yoga includes a broad spectrum of physical and psychological benefits [77–83].

The positive effects of qigong on health have been well documented [4–10,84–88]; nonetheless, this Chinese exercise has been the least studied of the eastern psychosomatic methods. In fact, although some studies have focused, at least partially, on the biochemical effects of yoga [89–91], including its effects on lipid profiles [92–93], the influence that qigong practice may exert on serum lipids does not seem to have been investigated and published to date, except in Chinese journals [94]. Likewise, there is no evidence linking qigong practice with changes in the biochemical parameters commonly used as markers of hepatic and renal function. Therefore we designed this study for the purpose of exploring the effects of a specific form of qigong on the serum levels of lipids (total cholesterol, HDL, LDL, triglycerides, phospholipids), enzymes (GOT, GPT, GGT), urea, and creatinine in a sample of healthy voluntary subjects.

Material and Methods

Participants

Twenty-nine healthy subjects (14 male and 15 female) with ages ranging from 18 to 21 were recruited from among the student population of the Faculty of Psychology of the University of Malaga to take part in this study. A psychological interview (also including the General Health Questionnaire of Goldberg and the trait form of the Spielberger State-Trait Anxiety Inventory, STAI) as well as a medical exam were carried out for the selection of participants. Exclusion criteria included: having consumed any drug or being under pharmacological treatment within the three months previous to the study, suffering any type of physical or mental chronic disease, or being overweight (according to the body mass index). None of the subjects practiced sports regularly or had experience with qigong or other such methods. Female participants were all within the first ten days of their last menstrual period. The selected participants were randomly assigned to an experimental group (16 subjects), which underwent qigong training, or a control group (13 subjects), which received no treatment. A homogenous distribution based on sex was made in both groups. All subjects volunteered to participate in the study and gave written informed consent. One experimental subject (male) decided to leave the study several days after the onset of the experiment and three more subjects (one male and two female) were removed from the sample for having missed qigong training sessions on more than two occasions.

Intervention

The experimental subjects were submitted to a qigong training program for a period of one month, practicing qigong for 30 minutes in the evening under the guidance of a qualified instructor of this discipline. This guided training took place from Monday to Friday in a room adjoining our laboratory, and the subjects were further encouraged to keep practicing on their own over the weekends. The amount of solo training varied from one subject to another, but typically consisted of one extra session on the weekend; this individual training usually had half the duration of the group sessions**.** The form of qigong taught and practiced in this study is known as "the eight pieces of brocade" (Ba Duan Jin in the Chinese Pinyin transliteration). This qigong method consists of one single sequence of exercises containing eight distinct movements which are repeated eight times each, therefore making a total of 64 physical moves to complete the entire set. Throughout the form, rhythmic breathing and a relaxed state of the mind are required. We chose this method of qigong due to its simplicity, its effectiveness, and the fact that it is a well known and widespread qigong style. Recently, five reports have focused on this qigong system and its health-promoting features [10,11,59,86,87].

Blood sampling

The day before qigong training commenced for the experimental subjects, blood samples were taken from all participants, experimental and control. When the qigong program concluded, blood samples were taken again in both groups. The biochemical parameters measured included: concentrations of lipids (total cholesterol, HDL, LDL, triglycerides, and phospholipids), serum enzymes (GOT, GGT, and GPT), urea, and creatinine. The blood samples were taken at 9.00 a.m. before breakfast and were venous blood samples drawn into vacuum tubes without additives and centrifuged within two hours of being drawn.

All serum biochemical tests were performed with a Cobas Integra model 700 multichannel analyzer (Roche Diagnostics, Indianapolis, IN, USA): blood urea was mesureed by urease/GLDH method, blood creatinine by Jaffe's reaction, both glutamic-pyruvic transaminase (GPT) and glutamic-oxaloacetic transaminase (GOT) were measured using an IFCC modified method without pyridoxal phosphate, and gamma-glutamyltransferase (GGT) was measured using a carboxi-GIUPA kinetic method (Szasz-Persijn). Total cholesterol, high-density lipoprotein (HDL) cholesterol, and low-density lipoprotein (LDL) cholesterol were calculated directly by an enzymatic color method (CHOD/PAP), and triglycerides (TG) by other enzymatic color method (GPO/PAP).

Table 1. Adjusted means in post-test for the concentrations of serum lipids, enzymes, urea, and creatinine in the control and qigong groups after performing ANCOVA with the respective pretest as covariants.

Biochemical parameters	Control group	Qigong group
Cholesterol (mg/dl)	161.30	155.99
HDL (mg/dl)	65.14	61.93
LDL (mg/dl)	85.42	84.29
Triglycerides (mg/dl)	53.81	48.70
Phospholipids (mg/dl)	179.75	163.68
GOT (U/L)	21.40	16.70***
GPT (U/L)	20.70	16.40**
GGT (U/L)	15.80	13.20*
Urea (mg/dl)	33.20	27.60**
Creatinine (mg/dl)	0.86	0.84

* p=0.09; ** p<0.05; *** p<0.01.

Statistical analysis

A between-group analysis of covariance (ANCOVA) was performed on several dependent variables: total cholesterol, HDL, LDL, triglycerides, phospholipids, GOT, GPT, GGT, urea, and creatinine. The qigong training was considered as an independent variable with two levels (absence or control group, and presence or experimental group) and pretest scores of the respective dependent variables as covariant. Thus the differences between the groups were estimated with the differences in the pretest scores removed.

Results

Effects of experimental treatment after adjustment for covariants were found for GOT [F(1,22)=10.7, p=.003], GPT [F(1,22)=4.32, p=.04], and urea [F(1,22)=6.51, p=.02]. In addition, the differences in GGT tended to statistical significance [F(1,22)=3.14, p=.09]. No significant effects were found for total cholesterol [F(1,22)=1.12, p=.30], HDL [F(1,22)=1.55, p=.22], LDL [F(1,22)=0.07, p=.78], triglycerides [F(1,22)=0.81, p=.37], phospholipids [F(1,22)=1,47, p=.23], and creatinine [F(1,22)=0.52, p=.47]. The adjusted means, as displayed in Table 1, show a lower score in the experimental group in all the significant variables.

Discussion

The main finding of this study is that the practice of qigong for the short period of one month induces significant changes in several blood biochemical parameters. Our results thus reveal that the qigong practitioners underwent a significant reduction in the serum levels of urea, GOT, GPT, and GGT (trend). To the best of our knowledge this is the first study reporting that qigong practice can significantly modify the serum concentrations of enzymes and urea.

Stress has been reported to play a key role in the changes of blood biochemical parameters, particularly of those related to hepatic and renal function. Numerous experimental studies have in fact pointed out the detrimental effects of stress on the physiology of these organs [95,96]. In this context, the practice of various forms of meditation, besides reducing stress symptoms, has been suggested to affect hepatic and renal metabolism. Jevning et al. [97], for instance, found that transcendental meditation decreased hepatic blood flow. This diminution of blood flow in the liver after meditation is coherent with smaller metabolic activity of this organ and has been said to occur owing to a blood flow redistribution, particularly affecting the brain and skin. In our study, the marked reduction in serum enzymes and urea may have occurred by means of a similar process, i.e. by a diminution of blood flow into the liver.

The decrease of serum enzymes in qigong subjects might have another interesting psychobiological explanation related to stress. Stress has been said to cause oxidative damage in the hepatic DNA [95] and hence cell damage, consequently releasing enzymes to the blood stream. Thus the lower concentrations of serum enzymes found in the experimental group seem to indicate less cell damage, comparatively, than in the controls. Therefore it is possible that the reduction of stress levels induced by qigong may account, at least partially, for these results. In fact, the hypothesis of an anti-stress effect of this Chinese psychosomatic exercise appears coherent with results from this same study published elsewhere [98] revealing fewer anxiety symptoms in subjects who underwent qigong training.

On the other hand, several studies have reported that the practice of exercise [36–39], and even a prolonged lack of muscular activity [99,100], can cause increases in blood urea. Given that qigong training frequently entails a series of slow physical movements with a strong focus in the mind, this peculiar psychosomatic approach could explain the lower biochemical values observed in the experimental group. In addition, since breath normalization is generally considered a fundamental effect of qigong, the variation in breathing pattern naturally induced by qigong could also have been involved in the marked reduction of blood urea levels that we found in our study. In fact, a link between changes in breathing and urea concentrations has been reported by Desay and Garote [101], who observed that Kapalabhati practice, a breathing technique of Hatha yoga, diminished urea concentrations. The washing out of CO_2 and the promotion of decarboxylation and oxidation mechanisms, whereby quieting of respiratory centers is achieved, have been suggested to play a key role in the effects on urea induced by this yoga breathing technique.

With respect to blood lipid levels, most of the papers that report reductions in blood lipid levels after psychosomatic practice employ subjects with some pathology, such as hypertension [72], hypercholesterolemia [45,46], and other conditions [53]. Although qigong practice could regulate lipid metabolism in patients with cardiovascular risk [94], our study appears to be the first to analyze the effect of qigong on blood lipid levels in young healthy subjects. Thus in our study the participants were healthy voluntary subjects who did not suffer from any disease and were not considered to be part of any at-risk group. Furthermore, it is likely that the good state of health of these subjects could represent an intrinsic difficulty to reduce values significantly that are already within the range of normality. Therefore, a possible explanation for the absence of significant results for these lipid measures can be ascribed to the healthy feature characteristic of the sample.

Apart from the established association between serum lipid concentrations and cardiovascular disease, blood lipid levels have also been linked to other clinical manifestations. In fact, a great number of studies have focused on the relationship between blood lipid levels and emotional wellbeing. [102]. Although a clear link between both factors has not yet been firmly established [103–105], most authors have found an inverse relationship; thus low lipid levels have been suggested to be related to emotional stress, depression, suicide, violent behavior, accidents, etc. [106–110]. We did not find significant differences between the two groups in the concentrations of blood lipid levels; nevertheless, we observed a better score in some psychological variables of the experimental group [98]. This is in agreement with results from other studies wherein the same qigong style was practiced [86,87].

It is important to emphasize that in this study, all biochemical values were within the range of normality in the two samples of subjects prior to the onset of qigong practice by the experimental group. In this context, the remarkable biochemical changes found in our study after one month of qigong training could be of potential clinical interest. While at first glimpse it may be difficult to foresee the relevance of the modulatory effects exerted by qigong on these biochemical variables, the mere decrease in these values might nonetheless suggest a beneficial effect. In addition, it is of note to take into consideration that these biochemical changes took place after the short time period of practice of four weeks. In this respect it would certainly be interesting to verify which effects could be induced after a longer period of training. In addition to this, a larger sample might be necessary to clarify and confirm the results obtained from this preliminary study.

Conclusions

The present findings demonstrate that daily qigong practice for a period of one month induces noteworthy modifications of diverse blood biochemical parameters, including GOT, GPT, and urea. The nature and direction of these changes seem coherent with a favorable biochemical effect of qigong, therefore suggesting that this modulatory effect might be clinically relevant. Further research is needed to shed light on the importance and scope of the results obtained from this study.

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