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Original Article

Effect of high temperature yoga exercise on improving physical and mental well-being of overweight middle-aged and young women

Yan-Hua Guo[1], Feng Wang[1], Jian-Ping Hu[1], Yi Wang[2], Li-Yan Zhang[1]

[1]*The Center of Physical Health, Henan Polytechnic University, Jiaozuo 454000, Henan Province, China;* [2]*The Lab of Human Body Science, Henan Polytechnic University, Jiaozuo 454000, Henan Province, China*

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Abstract: Objective: To explore the effect of high temperature yoga exercise on improving physical and psychological well-being of overweight middle-aged and young women. Design: 50 overweight middle-aged and young women from yoga clubs were selected. The indexes of their constitution, physiological functions, psychological adaptation were measured and compared before and after one year of uninterrupted high temperature yoga exercise. Results: The indexes of the subjects' constitution and physiological functions were remarkably uplifted ($P < 0.05$); their psychological adaptation was improved as well. Conclusion: Aerobics represented by high temperature yoga can improve body shape, lower lipid, reduce weight, and exert an evident therapeutic effect on improving physiological functions and boosting psychological well-being.

Keywords: Yoga, high temperature, overweight, women, physical health, psychological well-being, effect

Introduction

With the betterment of people's living standard, overweight population caused by over nutrition and lack of exercise is on the rise. Obesity both impacts body shape and induces diabetes, hyperlipidemia, hypertension, fatty liver, arteriosclerosis, myocardial infarction and the like, doing great harm to one's health [1, 2]. Aerobic endurance training is a major form of exercise to lose weight. In recent years, yoga, as a sports item which can reduce pressure, relax body and mind, keep one's figure and improve physical functions, is very popular among women. High temperature yoga, originating in Thailand (the training temperature is as high as 40°C), has a clear demand for ambient temperature. Its theory proposes that the most effective and, therefore, the most ideal way to lose weight and keep fit are to practice yoga at a high temperature [3, 4]. But the relevant confirmatory studies are lacking which are about the therapeutic effect of high temperature yoga on the well-being of overweight middle-aged and young women. In light of the current situation, this experiment studies physical function and psychological health indexes of overweight middle-aged and young women who persist in doing yoga and aims to provide theoretical foundation and positivistic data for practitioners.

Subjects and methods

Subjects

50 overweight, middle-aged or young female members of Zhengzhou yoga club who take part in high temperature yoga exercise were selected. They were aged from 18 to 48 and the average age was 36.8. The average height was (157.86 ± 3.71) cm, and the average weight was (72.48 ± 7.47) kg. They had no history of cardiovascular diseases, diabetes, epilepsy, or renal diseases, disease that are unfavorable for high temperature yoga practitioners.

Methods

Training arrangement: The subjects were trained every other day, 4 times a week, 90 minutes every time. The routine training involves 5 minutes' of warming up, 80 minutes' of the core training, and 5 minutes' of relaxation. The core

Table 1. Changes in weight, sebum thickness and body fat percentage before and after training ($\bar{x}$ ± s, n = 50)

Items	Weight (kg)	Forearm sebum (mm)	Shoulder sebum (mm)	Thigh sebum (mm)	Abdominal sebum (mm)	Body fat percentage (%)
Pre-training	72.48 ± 7.47	28.14 ± 5.42	34.29 ± 5.47	34.85 ± 3.16	36.12 ± 5.38	28.58 ± 2.37
Post-training	61.83 ± 7.58	25.78 ± 5.15	31.95 ± 5.18	29.59 ± 3.27	30.81 ± 4.74	24.44 ± 2.26

Note: compared with pre-training, $P < 0.05$.

Table 2. Changes in body circumference before and after training ($\bar{x}$ ± s, n = 50)

Items	Chest measurement (cm)	Waistline (cm)	Upper arm circumference (cm)	Thigh circumference (cm)	Calf circumference (cm)
Pre-training	93.22 ± 4.11	91.37 ± 6.16	34.33 ± 3.16	60.83 ± 4.62	43.75 ± 5.24
Post-training	90.71 ± 3.94	81.31 ± 6.11	29.89 ± 3.47	52.71 ± 4.23	36.78 ± 4.85

Note: compared with pre-training, $P < 0.05$.

training was high temperature yoga initiated by the Indian yoga master Bikram Choudhury and his wife. The training temperature was controlled at the temperature of human body, that is, 37°C or so. The core training included 26 stretching moves, the procedure was basically fixed, and one move should follow another. The training was characterized by aerobic metabolism and the intensity was set at 130~160/min in terms of the average heart rate.

Test content: Under the guidance of *Handbook of National Standard of Sports Training* and *Measurement and Evaluation in Physical Education*, self-paired indexes of the subjects, that is, indexes before they joined the club and one year after they exercised high temperature yoga were measured and compared. The subjects were also asked to fill in a questionnaire on their psychological self-evaluation concerning high temperature yoga before they took the second test.

Test method: Monitoring instruments and testing methods which apply to monitoring indicators of adults' constitution were unanimously employed to strictly examine weight, body circumferences, sebum thickness, body fat percentage, lipid parameters, blood pressure and vital capacity. The instrument models are: SENSOR MEDICS-2200 spirometer (American), JS7-G65-body composition analyzer (American), HEM-640 OMRON electronic sphygmomanometer (American) and Japan made Olympus 2700 automatic biochemical analyzer. Among all the indexes, weight, body circumferences, sebum thickness and body fat percentage were calculated directly computer-programmed body composition analyzer, and no additional formula was needed. Main measures of blood lipid included TC (serum total cholesterol), TG (triglycerides), LDL-C (low-density lipoprotein cholesterol) and HDL-C (high-density lipoprotein cholesterol) which reflect lipid status of patients. Two days before blood lipid was done, all the subjects avoided exercise or terminate treatment. The supper before blood lipid was forbidden. The next day, intravenous blood was taken when the subjects were devoid of food. The sphygmomanometer and the spirometer were used to collect data of diastolic blood pressure, systolic blood pressure, resting heart rate and vital capacity.

Psychological test: Psychological self-evaluation of the subjects concerning their participation in high temperature yoga was researched through observation and questionnaire. The questionnaires were handed out before the second test and immediately collected after the subjects filled in. The collected questionnaires were 46. The rate of recovery and efficacy were 100%.

Statistical analyses

Apply SPSS 13.0 software to statistical treatment. The measurement data was expressed in ($\bar{x}$ ± s); the comparison among groups adopted the *t* test; and $P < 0.05$ indicates that the discrepancy has statistical significance.

Results

After one year of high temperature yoga, physiological indexes like weight, sebum thickness,

Table 3. Comparison in lipid parameters before and after training ($\bar{x}$ ± s, n = 50)

Items	TC (mmol/L)	TG (mmol/L)	LDL-C (mmol/L)	HDL-C (mmol/L)
Pre-training	6.54 ± 0.39	1.98 ± 0.26	3.45 ± 0.29	1.02 ± 0.16
Post-training	5.20 ± 0.34	1.51 ± 0.25	2.91 ± 0.32	1.21 ± 0.15

Note: compared with pre-training, $P < 0.05$.

Table 4. Changes in resting heart rate, blood pressure, and vital capacity before and after training ($\bar{x}$ ± s, n = 50)

Items	Resting heart rate (time/min)	Diastolic blood pressure (mmHg)	Systolic blood pressure (mmHg)	Vital capacity (ml)
Pre-training	78.61 ± 5.16	78.35 ± 8.26	124.01 ± 10.57	2389.59 ± 215.21
Post-training	74.42 ± 4.88	75.46 ± 8.49	120.38 ± 9.62	2653.86 ± 229.38

Note: compared with pre-training, $P < 0.05$.

Table 5. Self-evaluation of dieting, sleep and emotions after training (n = 50)

Appetite n (%)			Sleep n (%)			Emotions and interpersonal relationship n (%)		
Improved	Unchanged	Worse	Improved	Unchanged	Worse	Improved	Unchanged	Worse
6 (12)	33 (66)	11 (22)	47 (94)	3 (6)	0 (0)	48 (96)	2 (4)	0 (0)

body fat percentage, lipid parameter, body circumference, resting heart rate, blood pressure and vital capacity were more or less improved ($P < 0.05$). See **Tables 1-4**. Dieting of 32% of the subjects were improved, 94% reflected better sleep and 96% of them gave positive feedback about emotions and interpersonal relationship (**Table 5**).

Discussion

Statistics listed in **Tables 1-3** prove that aerobics represented by high temperature yoga exert a remarkably positive effect on improving body fat percentage, lipid parameters and body shape of overweight middle-aged and young women. The mechanism at work is as follows. First, in the process of aerobics, the energy source for muscular contractile activity in the beginning is glycogen. When exercise lasts for over 45 minutes, free fatty acids supply 50% up to 70% of energy required. Meanwhile, muscles demand to take and use more free fatty acids and glucose in blood, which consequently leads to the release of a lot of free fatty acids and the shrinking of fat cells [5, 6]. Furthermore, additional fat is consumed and transformed into blood glucose. As a result, body dwindles and weight goes down [7]. Second, exercise excites sympathetic nervous system, boosts catecholamine activity, increases the amount and activity of lipid oxidation enzymes, and reduces plasma insulin. All this contributes to lipid metabolism, speeds up the decomposition of LDL and chyle rich in triglyceride, and eventually enhances the function of free fatty acids [8-10]. Third, aerobics both raises the consumption of thermal energy and promotes the activity of lipoprotein lipase so as to transport and decompose triglycerides and reduce lipids in blood. For instance, many studies have revealed that exercise can promote LPL activity to help muscles in motion to draw on FFA. As a result, FFA in blood is transferred to muscles so that LPL activity in adipose tissues and LPL level in serum are uplifted. TC and TG metabolism are sped up and fat used as energy increased, having a positive effect on serum metabolism [11-14]. Fourth, when the body exercises in a hot environment, energy metabolism is influenced by the hot environment. Temperature rise leads to organic consumption of energy in the hot environment. Relevant studies have indicated that the body demands more of energy, 10% to 40% or so. In the hot environment of 30 to 40 degrees, when the temperature rises by 1°C, energy consumption increases by 0.5% [15-17]. Fifth, normal dieting falls down after the overweight people undergo exercises of appropriate intensity in high temperature. What is more, yoga advocates dieting, controlling fat-rich meat and replacing meat with fruits and vegetables. So the intake

of fat lowers, consumption rises, and body fat is reduced. Intake of energy is less than consumption. And the effect of reducing fat, keeping fit and improving physical shape is achieved.

In the process of doing yoga, practitioners are required to stretch limbs, aided with deep breath. Various studies have found that deep breath promotes vital capacity and lengthens the time of deep inhale, which allows lungs sufficient time to exchange air and improve their functions [18, 19]. In addition, deep inhale exercise facilitates lungs to adapt more effectively, lowers elastic resistance, promote vital capacity and hopefully pacify interstitial lung diseases [20]. For instance, inverse breathing and abdominal breathing reinforce diaphragmatic contractility and efficiency, coordinate the motions of diaphragmatic and abdominal muscles, increase tidal volume, reduce functional residual volume, enhance alveolar ventilation rate, lower respiratory consumption, ease breathing difficulty, and improve ventilation function [21, 22]. In the process, apart from the respiratory movements of the lung, the stretching of the upper limbs and the body also improves endurance, adapt the anocelia, reduces the mechanic movements of inspiratory intercostal muscles, and strengthens motional function of diaphragmatic and abdominal muscles. Studies also verify that lasting and systemic aerobics can also economize functions of such indexes as resting heart rate, quantitative load rate, blood pressure and cardiac output. Aerobics help improve indexes concerning cardiopulmonary functions [23, 24]. That accounts for the data listed in **Table 4** in which cardiopulmonary indexes were improved. Besides, aerobics, represented by yoga, require that practitioners relax physically and mentally, coordinate body and mind to soft music, and become a part of nature. Practitioners benefit from yoga for they demonstrate a peaceful mind and a healthy body. Statistics in **Table 5** imply that, after over one year of yoga exercise, the subjects showed the signs of a good appetite, sound sleep, harmonious interpersonal relationship and quality life.

The study signifies that the 50 overweight middle-aged and young women showed remarkable improvement in every index after doing yoga systematically for one year by comparing their changes seen in body fat, physiological functions and psychological self-evaluation. The study shows convincingly that aerobics, represented by high temperature yoga has a remarkable effect on improving physical and mental well-being of overweight women.

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Disclosure of conflict of interest

None.

Address correspondence to: Dr. Feng Wang or Dr. Jian-Ping Hu, Health Center of Physical Education Institute of Henan Polytechnic University, 2001 Shiji Road, Jiaozuo 454000, Henan Province, China. Tel: +86-13839170406; +86-13203909006; E-mail: wangfeng@hpu.edu.cn (FW); hnjzhujp@126.com (JPH)

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