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Study of Weight Loss Parameters Among Sedentary, Overweight Postmenopausal Females Using Different Time Models of Aquafit

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Abstract

Background: Although time models of Aquafit are necessary among clinical guidelines to reduce weight, their implications on the health of the body are still controversial.

Objectives: This study aimed to examine whether different time models of Aquafit per se would have beneficial effects on weight loss parameters.

Methods: This prospective experimental research was conducted at the Ukrainian Sports Medicine Center (Kyiv, 2017) for 12 weeks. Selected volunteers from sedentary, overweight postmenopausal females (66 individuals) were randomly divided into two exercise programs, containing 33 females per group: moderate-intensity continuous training (MICT, mean age and BMI of 53.5 ± 6.3 years and 28.6 ± 1.2 kg/m^2, respectively), and high-intensity interval training (HIIT, mean age and BMI of 54.6 ± 5.4 years and 28.7 ± 1.1 kg/m^2, respectively). Both study groups performed water aerobics with three sessions of 60 minutes a week with similar energy expenditures (1500 kcal per week). Parameters of weight loss, such as body mass, BMI, lipid profile, and circumference of the waist, have been calculated before and after the study.

Results: Compared with initial data, all studied parameters in both intervention groups were significantly decreased ($P < 0.05$). Significant differences were only found in high-density lipoprotein cholesterol (HDL-C) between MICT and HIIT groups ($P < 0.001$). As well as, total cholesterol (T-C) to HDL-C ratio in HIIT was increased more than the MICT group (respectively, 0.75 and 0.69; $P < 0.001$).

Conclusions: Weight loss caused by Aquafit results in the decrease of pro-atherogenic lipoproteins (T-C and LDL-C) in both groups of females during the menopause, whereas a further rise of HDL-C increases as a critical element of cholesterol transport, only with HIIT.

Keywords: Body Mass Index, Body Weight, Circuit-Based Exercise, Exercise Therapy, High-Intensity Interval Training, Postmenopause, Sedentary Behavior, Water Sports, Weight Loss, Women's Health

1. Background

Excessive weight is raised throughout the world and more than 80% of patients with coronary heart disease (CHD) suffer from it (1). Weight reduction is "broadly effective" risk factor intervention (1), and physical exercise is defined as a necessary component of the behavioral program in losing weight (2-4). Some researchers also believe that the risk factors of CHD in people with overweight depend on exercise-induced weight loss (5, 6). Therefore, the components of sports advice for doctors and trainers are essential. However, the optimal regime about the exercise-time model is still uncertain and many researchers have tried to compare the efficacy of moderate-intensity continuous training (MICT) versus high-intensity interval training (HIIT). Research in the exercise-time field indicates that interval training versus continuous training equally improves CHD (7). But some researchers do not think so and they state the effects of these two exercise methods on weight reduction and CHD are not the same (8-10). Water sports, as a physical exercise, have been extensively recommended for older adults with excessive weight (11). This modality of physical activity has less effect on the joints than exercise training performed on land, and the body "loses" about 90% of its weight when immersed in water up to shoulder level (11, 12). The fact that body mass is not a limiting factor for their physical exercises and is also associated with improving physical fitness (13, 14), body composition (15), and cardiorespiratory health (11, 15) has led to an increase in interest in water sports. Although time models of Aquafit are necessary among clinical guidelines to reduce weight, the implications of MICT versus HIIT on the health of the body are still controversial (16). Different aspects of Aquafit exercises have been studied by numerous researchers. Bocalini et al. (17) compared the training response to aqua- and land-based exercise impacts on physical fitness. Bacchi et al. (18) studied aquatic activities during pregnancy. Rahmani et al. (19) and Nascimento et al. (20) reviewed the effect of Aquafit exercise on postural steadiness. However, the influences of aqua-based exercise on weight loss parameters, especially after menopause, have not been fully explored so far. On the other hand, given the diverse effects of exercise-time models (7, 8, 21), the role of Aquafit in weight loss and CHD is an intriguing question.

2. Objectives

Therefore, this investigation has studied whether different time models of Aquafit per se (as a part of an exercise program) would have positive effects on parameters of weight loss, such as body mass index (BMI), lipid profile, and circumference of the waist in sedentary overweight females after menopause.

3. Methods

3.1. Study Population

Sixty-six healthy and normolipidemic participants were selected from among 79 females who had been joined to the weight loss program of the Ukrainian Sports Medicine Center (Kyiv, 2017). The sample size (~ 66) in this finite population was calculated by the Cochran formula for 0.05 (error of 5%). The inclusion criteria for the selection of participants in this prospective experimental research were: sedentary lifestyle, overweight, menopause, stability of weight over three-month ($\pm$ 2 kg), non-smokers, blood pressures less than 140/85 mmHg, and without medical contraindications for Aquafit. Individuals with heart disease, type I and II diabetes, psychiatric disorders, diseases of infectious-contagious, orthopedic limitations, Individuals who lost three consecutive sessions or more than one-third of the session, any history of taking drugs (especially statins, fibrates, hormonal replacement therapy) or food supplements for weight control were removed from the study.

Computations of weight, height, and BMI were described in more detail elsewhere (2, 3, 22). In this regard, BMI of 25 to 29.9 kg/m^2 was characterized as overweight. Measuring waist circumference was conducted standing, after breath out and just above the pelvic bone using a measuring tape. The physical activity level was assessed by a customized self-report questionnaire survey that was used to select menopausal females with a sedentary lifestyle. The questionnaire was the scale of Likert-type consisting of seven items from "not at all" (first point) to "Every day" (seventh point) (21). The frequency of exercises from 1 to 2 times per month or less was considered a sedentary lifestyle (2, 3, 22). Assessments of leisure-time physical activity were performed using a structured interview and were also completed by seven-day physical activity recall (23). Evaluation of energy consumption was carried out using the food frequency questionnaire developed by Block et al. (24) that its validation has been confirmed previously (24).

Sample of fasting blood was obtained after one hour of rest under a semi-recumbent position in the morning (9 to 10 a.m.) before and after the study. Blood samples after collection in tubes containing heparin were immediately centrifuged, and plasma was isolated for analysis. The measurement of plasma levels of total cholesterol (T-C), and low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C) was performed using the enzymatic method (using COBAS, Roche Diagnostics, Germany).

3.2. Interventions

A total of 66 eligible participants were randomly divided into one of the two following groups. Study group MICT consisted of 33 females (mean age and BMI of 53.5 $\pm$ 6.3 years and 28.6 $\pm$ 1.2 kg/m^2, respectively) with moderate-intensity continuous training and study group HIIT included 33 females (mean age and BMI of 54.6 $\pm$ 5.4 years and 28.7 $\pm$ 1.1 kg/m^2, respectively) with high-intensity interval training. The protocol of exercise published by Takeshima et al. (15) was adopted with minor changes, and it proved to be effective in improving the physical fitness of older people. The stage of warming-up for 10 minutes did use warm-up and stretching movements. After this, the participants performed 40 minutes of aquatic training consisting of 30 minutes of dancing and walking or both combined as endurance movements and ten minutes of the resistance movement. Resistance movements were carried out by water-resistant products such as plastic dumbbells and foam spaghetti. Resistance movements were comprised of large muscle groups of the upper (biceps curl, chest press, and lumbar rotation) and lower (leg abduction and adduction, knee flexion and extension, leg curl and leg press, and press of the calf) extremities. Each exercise was accomplished by 10 - 15 repetitions according to calorie expenditure. Finally, 10 minutes of cool-down/relaxation movements (composed of stretching and slow walking) were performed.

Energy expenditure in both groups was the same (1500 kcal per week) that has been converted into minutes per week. The duration of the weekly exercises was adjusted accordingly. Heart rate (HR) monitors (RS400, Polar Electro OY, Kempele, Finland) were used to compute energy expenditure (25). The heart rate, frequency, and duration of the exercise have also stored on the monitors to ensure high exercise compliance. The exercise session was conducted in three weekly sessions (on Mondays, Wednesdays, and Fridays) in the three months. Aquatic exercises were continuously performed in the MICT group, and HIIT carried out in a series (four standardized exercises lasting one minute each with intervals of 90 seconds between them and repeated four times) with intervals in a circuit-based exercise. For the rest of the intervals, they had a light walk to the next station (to continue the exercise), and while waiting, they walked inside the pool (back and forth) to use active recovery. Heart rate monitoring was measured by the formula of maximum heart rate (HRmax) = 220 - age (years). In this study, HR monitoring in the MICT session was made up three times during and after every session. Also, HR monitoring in HIIT was immediately calculated after each exercise. Based on the ACSM recommendation (26), exercises intensity in MICT was set between moderate to vigorous intensity (70% to 85% of HRmax, respectively), and the target zone for HIIT was set at a vigorous intensity (90% to 95% of HRmax).

3.3. Method Management

During the study, participants took part in weekly meetings (included an assessment of exercise, diet, and weight loss trajectories). Alterations in leisure-time physical activity or energy consumption are associated with potentially conflicting research implications. Therefore, participants were asked to keep their conditions during the research. It was also ordered to announce any difficulties that could affect their participation in research (2, 3, 22). The research complies with all relevant national statutes, institutional policies, and principles of the Helsinki Declaration. The Institutional Research Ethics Committee approved informed consent forms and the application of human ethics. All subjects were informed of this research, and after getting the medical certificate of the absence of a ban on research, supplied a signed informed consent before enrollment.

3.4. Statistical Methods

Descriptive pre- and post-study data are expressed as means ± standard deviation. Normal distribution of data was confirmed utilizing the test of Kolmogorov-Smirnov. Paired *t*-test and Independent *t*-test were utilized to compare results within and between groups, respectively. Differences in the distribution of categorical variables from one another were studied using Pearson's chi-squared (χ^2) test. The significance level was considered $P < 0.05$. Statistical analyses were carried out by the software of SPSS version 23.0 (for Windows).

4. Results

In all groups, three females did not complete the research, so out of 66 individuals, three participants dropped out: one from the MICT during the intervention (lost the motivation) and females from HIIT because of dissatisfaction with their randomization. The initial characteristics of the final sample size are given in Table 1.

Table 1. Descriptive Characteristics at Baseline in the Groups[a]

Parameter	MICT Group	HIIT Group
Female, n	32	31
Age, y	53.5 ± 6.3	54.6 ± 5.4
Height, cm	167.9 ± 4.4	168.1 ± 5.3
SBP, mmHg	128.5 ± 6.4	127.6 ± 5.6
DBP, mmHg	80.3 ± 3.4	80.2 ± 3.5

Abbreviations: DBP, diastolic blood pressure; HIIT, high-intensity interval training; MICT, moderate-intensity continuous training; SBP, systolic blood pressure.
[a]Values are expressed as number or mean ± SD.

Completion rates between groups were analyzed using χ^2 and did not show a significant difference. Pre-study analysis of weight loss parameters revealed that there were no significant differences between the studied groups (postmenopausal females who finished the study). As shown in Table 2, comparing all values of weight loss parameters in pre- and post-study showed significant differences between the two groups.

According to the study outcomes, the mean weight loss of MICT and HIIT was 5.2 kg and 4.9 kg, respectively. Although weight loss at three-month was higher in MICT, it was not significantly different from HIIT ($P > 0.05$). Similar changes were observed between groups in waist circumference, BMI, T-C, and LDL-C ($P > 0.05$). The HDL-C values indicated that there were significant differences between MICT and HIIT ($P < 0.001$). The HDL-C increasing mean was 1.8 mg/dL for MICT, and 9.3 mg/dL, for HIIT (Table 2 and Figure 1).

5. Discussion

Menopause may partially explain the cause of the acceleration of CHD with age (27). Moreover, aging-induced

Table 2. Descriptive Characteristics of Postmenopausal Females Before and After the Study[a]

Parameter	MICT Group			HIIT Group		
	Baseline	Three-Month	P Value[b]	Baseline	Three-Month	P Value[b]
Mass, kg	80.5 ± 4.3	75.3 ± 5.7	0.01	81.2 ± 5.3	76.3 ± 6.2	0.03
BMI, kg/m²	28.6 ± 1.2	26.7 ± 1.8	0.03	28.7 ± 1.1	27 ± 2.1	0.02
Total-C, mg/dL	178.7 ± 8.4	149 ± 8.2	0.04	180.6 ± 8.2	153.1 ± 8.1	0.03
HDL-C, mg/dL	51.7 ± 3.3	53.5 ± 3.4[c]	0.02	52.1 ± 3.5	61.4 ± 3.4	0.01
LDL-C, mg/dL	110.3 ± 5.2	90.5 ± 4.8	0.02	113 ± 5.5	94.6 ± 4.6	0.03
Total-C/HDL-C ratio	3.31 ± 0.3	2.62 ± 0.2[c]	0.03	3.28 ± 0.3	2.53 ± 0.2	0.04
Waist circumference, cm	100.8 ± 3.4	92.1 ± 5.5	0.04	101.3 ± 4.3	92.8 ± 2.9	0.03

Abbreviations: BMI, body mass index; HDL-C, high-density lipoprotein cholesterol; HIIT, high-intensity interval training; LDL-C, low-density lipoprotein cholesterol; MICT, moderate-intensity continuous training; Total-C, total-cholesterol.
[a]Values are expressed as mean ± SD.
[b]$P < 0.05$ in comparison with pre-research.
[c]$P < 0.001$ in comparison with HIIT.

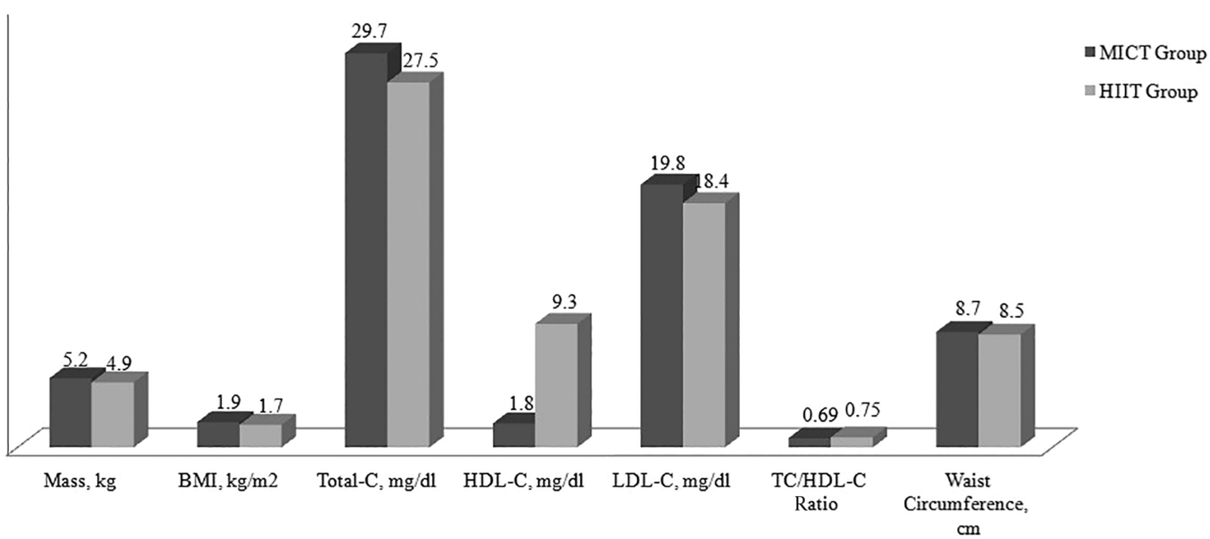

Figure 1. Values of monitored parameters between MICT and HIIT groups over 12 weeks are shown

excessive weight (28) is an independent risk factor for CHD progression and development (1) due to hyperlipidemia (29, 30). In this research, the effects of weight loss (body mass and metabolic profile impacts) have been studied using time models of Aquafit per se (MICT and HIIT) in overweight postmenopausal females with a sedentary lifestyle. The primary findings were that lipoproteins of pro-atherogenic, such as LDL-C and T-C, were decreased with exercise-induced weight cut (Table 2 and Figure 1). Lowering weight and lipoproteins of pro-atherogenic were similar in both time models of Aquafit, while enhanced HDL-C levels involved in cholesterol transport and T-C/HDL-C ratio in HIIT had been more than MICT among sedentary, overweight postmenopausal females (Table 2 and Figure 1). These findings confirmed earlier research, which suggests that the exercise-time models of Aquafit have a positive effect on cardiovascular risk and effective for elderly females (1, 6). Previous data have shown that weight cut and changes of lipid profile take at least three months (9, 10). So, the study turned into stopped after three-month. Triglyceride levels of the blood are connected to dietary; therefore, the variable of TG was removed from this study (9, 10).

Sex hormones play a crucial role in the etiology of excess weight and greatly affect the distribution of fat in the body and the differentiation of adipocytes (31, 32). The sexrelated changes in the distribution of adipose tissue and body composition after menopause are among the clinical observations linking estrogen with the development of adipocytes (32). In the process of menopause, females experience the change of fat distribution from a gynoid to an android (32, 33) and are three times more prone to excessive weight and cardiometabolic disorders than females in the pre-menopause phase (27).

There was no significant weight cut difference between groups over a 12-week period, which can be because all groups have consumed similar amounts of energy. Concurrently, the results of the study stated that raising the level of HDL depends on time models of Aquafit (Table 2 and Figure 1), not energy expenditure. Since the T-C/HDL-C ratio is a criterion for evaluating the risk of CHD, changing HDL-C is essential in healthcare (34). The reduction ratio of TC to HDL-C in HIIT was higher than the MICT. Moreover, the study findings propose that changing the TC and LDL-C is consistent with body weight changes, which is identical to other results of researchers (6, 35). Diet in both groups was not the same. Consequently, cholesterol levels in the diet do not seem to affect the results. These outcomes are inconsistent with the findings from Rezaeipour et al.'s (3) study concerning the effects of weight loss as a result of dietary interventions and meal replacement during exercises in men.

In the course of the study, except for the non-commitment of some individuals who were eliminated from the research, there were no other legal constraints, such as potential bias, multiple analyzes, and so on. It is advisable to study the effects of exercise-time models of Aquafit for older men.

5.1. Conclusions

Both exercise-time models of Aquafit may provide a significant reduction in body mass, LDL-C, and T-C during a 12-week study. Even though the increased HDL-C levels and a reduced ratio of TC/HDL-C occurred in the HIIT more than MICT may implicate a significant efficacy for the interval training model. The study results can be clinically helpful for time models of Aquafit prescription in sedentary overweight females during postmenopausal who engage in weight loss efforts.

Supplementary Material

Supplementary material(s) is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

Footnotes

Authors' Contribution: Mohammadreza Rezaeipour and Vladimir Ivanovich Nychyporuk made substantial contributions to the conception and design, acquisition of data, analysis and interpretation of data. Mohammadreza Rezaeipour was involved in drafting the manuscript, revising it critically for important intellectual content. All of the authors read and approved the final manuscript.

Conflict of Interests: The authors declared no conflict of interests.

Ethical Approval: The research complies with all relevant national statutes, institutional policies, and principles of the Helsinki Declaration. The Institutional Research Ethics Committee has been approved informed consent forms and the application of human ethics [NMAPE, (2017) No. 04112-08].

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