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Impact of Low-Volume High-Intensity Interval Training and Moderate-Intensity Continuous Training on Physical Performance and Quality of Life among Postmenopausal Women

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Abstract

Background: Menopause is one of the life stages for women that marks the end of reproductive years. Physical, emotional, mental, and social well-being can all be impacted by the hormonal changes brought on by menopause. Hence, the study aims to determine the effect of Moderate-Intensity Continuous Training (MICT) and High-Intensity Interval Training (HIIT) on cardiovascular parameters and quality of life in postmenopausal females.

Methods: A two-arm, randomized controlled trial was conducted on 40 postmenopausal females, recruited via envelop method of simple random sampling technique into Group-A, who received HIIT and Group B, who received MICT. Firstly, informed consent was taken from the participants by explaining all the protocols and procedures. Following the assessment, both groups received six weeks of exercise training thrice a week with 40 minutes of HIIT and 50 minutes of MICT, respectively.

Results: Predicted VO2max increased statistically and practically significantly in response to the HIIT intervention (6.92 ml/kg/min; p=0.01), while it changed marginally and practically in the MICT group (2.8 ml/kg/min; p>0.05).

Conclusion: The results indicate that the HIIT group experienced a statistically and clinically significant improvement in predicted VO_2 max compared to a slight significant change observed in the MICT group.

Keywords

Cardiorespiratory Fitness, Exercise, Obesity, Quality of Life.

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Introduction

Menopause is a physiological process which causes the discontinuation of the regular monthly cycle in women, thus the process leads to secondary infertility due to a decreased level of estrogen[1]. According to data from the World Health Organization (WHO), the average menopausal age is 51.4 years, with a range of 45 to 55 years. However, this range differs among various nations and ethnic groups[2]. It can occur naturally when menopause happens as a result of the typical age-related process. Sometimes, surgical menopause occurs due to removal of ovaries secondary to any disease or condition[3]. As a result, the condition escalates the risk of cardiovascular disease (CVD), as well as neurological and psychological disorders[3]. But compared to natural menopause, the risk is higher for women who have surgical menopause[2]. Women normally have a lower risk of cardiovascular disease than men, although this advantage decreases as estrogen levels fall dramatically after menopause[2]. As a result, cardiovascular health in women's midlife should be a primary goal and a crucial first step in preventing CVDs. The menopausal transition is linked to an increased risk of CVD4. The Atherosclerosis Risk in Communities (ARIC) study's findings showed that the death rate from cardiovascular disease (CVD) is on the rise among women under the age of fifty-five. Furthermore, women who enter menopause early are more likely to experience CVD events in the future[5.] According to a meta-analysis, experiencing menopause before the age of 50 is linked to a 25% higher risk of CVD[6]. Another meta-analysis discovered that women who go through menopause before the age of 45 had a 50% higher risk of coronary heart disease (CHD), which reduces their physical performance and quality of life (QoL). Menopause, then, marks a significant chance to implement prophylactic measures.

Multiple preventive approaches have been developed to maintain menopause related complications. Various reports have linked the administration of estrogen for alleviating menopausal symptoms to positive impacts on the cardiovascular system. A substantial body of evidence from molecular, biochemical, preclinical, and clinical investigations supports this outcome resulting from estrogen's actions[8]. Despite its many advantages, Hormone Replacement Therapy (HRT) is still not widely used in the general public due to a lack of knowledge regarding possible side effects and difficulties, particularly those affecting the endometrium[9]. Thus, a need for non-pharmacological treatment is crucial to manage the complications of menopause. Exercise has proven to be a potent nonpharmacological intervention to prevent females from developing fatal postmenopausal consequences[10]. Various exercises have been found to be beneficial in protecting from a disease that includes aerobic, anaerobic, and combination of

both[11]. Numerous studies have demonstrated how aerobic exercise training improves postmenopausal women's cardiovascular health and oxygen absorption. Moreover, studies reinforced the role of resistance training as it is counted as another approach that decreases the post-menopausal related symptoms and increases the health-related QoL[12]. Nonetheless, a shortage of available time has been identified as a hindrance preventing individuals from adhering to exercises. High-Intensity Interval Training (HIIT) has therefore been suggested as a time-efficient alternative more recently[13]. The benefits of HIIT stem from its ability to produce an energy expenditure that is comparable to that of aerobic exercise. The purpose of this research is to determine how postmenopausal ladies' cardiovascular parameters and quality of life are affected by two distinct training methods: (HIIT) and moderate-intensity continuous training (MICT).

Methodology

Study Setting

The study was conducted in fitness gyms located in Karachi.

Study Design

A two-armed Randomized Control Trial (RCT) design was conducted on post-menopausal women age between 45-55 years recruited via envelop method of simple random sampling technique.

Selection Criteria

Post-menopausal women aged 45 to 55 who did not have a regular exercise program were included. However, those who had undergone HRT, had a history of hypertension (systolic BP>140 mm Hg, diastolic BP >90 mm Hg), were on anti-hypertensive medication, or had any medical condition that would preclude them from participating in exercise testing or training—such as osteoporosis, unstable angina, or uncontrolled arrhythmias—were excluded for participation in the study.

Data Collection Procedure

The study was approved from Memon Medical Complex Hyderabad Reference No: (**712004DPT)**. Forty participants were divided into two groups through randomization using envelop method. Group-A participant performed HIIT training while group B performed MICT training. Informed consent was taken from the participants by explaining all the protocols and procedures. Resting heart rate and blood pressure was recorded using a pulse oximeter and sphygmomanometer respectively. Following the assessment, both groups received 6 weeks of exercise training thrice a week with a duration of 20 minutes of HIIT and 30 minutes of MICT respectively.

Intervention protocol

GROUP A

- The HIIT training was performed by Group A thrice a week for 6 weeks with a total of 18 sessions on a cycle ergometer. The protocol consists of a warm-up of 5-10 minutes followed by 10 bouts of 1-min exercises at 90 % HRR 10 bouts of 1- min resting (pedaling slowly at 50% of HRR). A cool down of 10 min exercises at 40 % of HRR was performed after the session. During the HIIT session, participants were asked to perform cycling at maximum intensity for 1 minute. Thus the total training duration was 15 minutes.

GROUP B

- The participants in Group B performed MICT on a cycle ergometer. The training session included a warm-up of 5-to-10 minutes of cycling at 40% of maximum heart rate (MHR), and a 30-minute riding portion at 60 to 70% of peak heart rate. At the end, a 5-to-10 minute's cool-down consisted of cycling at 40% MHR.

- After the 6 weeks of training the rate pressure product, 6-minute walk test and menopausal rating scale scores were recorded for post intervention assessment.

Ethical Considerations

Confidentiality of data was kept for all participants considering it an integral right of an individual to maintain personal security. Informed consent was obtained from all participants as a legal responsibility to aware a patient or client of the risks and outlay involvement in a treatment. The right of the participant to withdraw from a study at any instance was assured.

Results

The study involved a group of 40 postmenopausal women, all identified as healthy elderly individuals, having an average age of 52.26 and 54.5 years in each of the two intervention groups i.e. is HIIT and MICT respectively. As per the standards set by the ASIAN guidelines, the participants exhibited an average BMI of 27.74 ± 2.9 kg/m² and 27.71 ± 3.1 in HIIT and MICT respectively, classifying them within the obese range. However, it has been postulated that for the elderly population, a BMI exceeding 30 kg/m² is requisite to denote an escalated risk of cardiovascular disease, thereby signifying that the studied elderly individuals remained within the bounds of healthiness. It is pertinent to note that their BF (38.167%) positioned them at high health risk with regard to their age cohort (Table-1).

Table-1 Demographic characteristics of participants		
Factors	**HIIT**	**MICT**
N	20	20
Age (years)	52.26±3.23	54.5±4.3
Height (cm)	163.2±7.5	164.9±7.8
Body mass(kg)	73.8±12.4	75.1±11.23
BMI (kg/m^2)	27.74±2.9	27.71±3.1
Body fat (%)	37.3±6.6	36.7±6.9

Mean±S.D

Following the 16-week intervention, the results of cardiovascular fitness are summarized in Table 2. Group-A demonstrated a significant reduction in termination time (106 s; p=0.003; Effect Size [ES]=0.87). On the other hand, Group-B showed a marginally significant improvement (21 s; p>0.05; Effect Size=0.22). As a result, the estimated VO2max for the HIIT group increased statistically and practically significantly (6.92 ml/kg/min; P =.01; ES = 0.85), whereas the MICT group had a minimal significant change (2.8 ml/kg/min;p>0.05; ES=0.19).

Table-2 Changes in cardiorespiratory fitness					
Variables	**Group-A Mean±S.D**	**Group-A Mean±S.D**	**Group-B Mean±S.D**	**Group-B Mean±S.D**	**P value<0.05)**
Termination time (s)	265.5±119.2	371.5±91.2	269±154.2	290±79.8	**<0.05**
Predicted VO2max (ml/kg/min)	18.23±10.01	25.15±5.8	21.6±11.4	24.4±7.6	

The SF-36 version 2 questionnaire, which measures quality of life, yielded significant results in a 16-week intervention comparing HIIT and MICT groups. In the "role/emotional" dimension, the HIIT group showed a statistically significant improvement (3.9; p<0.05). The MICT group demonstrated substantial improvements (p<0.05) in "mental health" (5.4), "role/physical" (3.9), "vitality/energy" (3.9), and "social functioning" (7.2). Although there were notable gains in both groups, the particular areas that were impacted varied, indicating the complex effects of each training method on different facets of the participants' quality of life.

Table-3 depicting effects of HIIT and MICT on QoL				
Subscales-SF-36-v2	Group-A Mean±S.D	Group-A Mean±S.D	Group-B Mean±S.D	Group-B Mean±S.D
Physical functioning	52.1±2.9	53.9±1.3	51.3±3.5	52.2±2.4
Role/physical	53.4±4.5	56.4±3.2	52.4±2.9	56.8±1.8
Bodily pain	56.4±7.2	52.6±4.1	55.2±5.9	53.5±6.1
General health	54.3±5.4	56.8±3.8	54.5±5.8	55.9±7.6
Vitality/energy	56.8±3.2	57.8±6.5	55.6±3.9	57.8±4.8
Social functioning	54.2±7.6	56.5±4.8	55±4.5	58.6±5.4
Role/emotional	53.2±5.7	56.8±5.2	54.5±4.3	57.8±4.5
Mental health	57.2±6.3	59.7±5.2	51.3±7.5	56.7±6.5

Discussion

The results of the study revealed that both interventions were found to be effective in improving the variables, however the effects of HIIT was more prominent in improving physical performance as compared to MICT group. Multiple studies revealed the effects of HIIT in different conditions however the data regarding its effect on physical performance among postmenopausal women was found scared. As reported in a study by Rýzková et al in 2018[14], in which effects of aqua fitness and HIIT was compared on physical fitness and resting heart rate. The results revealed that HIIT (Tabata format) group showed a decrease in resting heart rate and improved physical performance ($p<0.05$). In another comparative study 22 post-menopausal women were enrolled on which low volume high intensity and continuous training was performed. The findings showed that although the total time commitment (∼2.5 vs. ∼5 h) and training volume (558 vs. 1,237 kJ) were significantly lower for HIT compared to CT, the HIT group only experienced significant increases in peak oxygen uptake from baseline ($P = 0.01$) ($\Delta = 2.2$ mL kg−1 min−1; P for interaction = 0.688). Both groups showed improvements in the length of the exercise test (HIT, 13%; CT, 5%; P for interaction = 0.194)[15]. In another study the effect of HIIT and MICT on cardiopulmonary endurance was compared among middle age and older females that revealed a significant improvement in VO2 max and diastolic blood pressure among both groups ($p<0.05$), however, the systolic blood pressure was more improved in the HIIT group[16]. Similarly in a study, the effects of exercise and health promotion on HRQoL, cardio metabolism and physical health assessment were evaluated among post-menopausal women. Significant improvements in cardiometabolic status, physical fitness, body weight, body mass index, cardiorespiratory fitness, and flexibility were observed after this intervention[17]. Additionally, a meta-analysis reported the cardiometabolic effects of HIIT in adults which showed

that it can be used as an effective training protocol for enhancing VO2 max and several cardiometabolic risk factors[18]. Despite all the benefits, the literature is scarce. Therefore, more researches are required that would determine the effects of HIIT on cardiovascular endurance among post-menopausal female.

Conclusion

This study highlighted the potential advantages of HIIT in improving postmenopausal women's exercise capacity as it showed statistically significant improvement in VO2max in comparison to MICT group that only a showed a marginally significant change. Furthermore, on SF-36 dimensions there were no statistically significant changes in physical functionality, body discomfort, general health, or the physical component between the two groups.

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Conflict of Interest

None.

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None.

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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design: Batool S

Acquisition, Analysis or Interpretation of Data: Batool S, Sabir S

Manuscript Writing & Approval: Sabir S

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.