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Home-Based HIFT Altered Quality of Life and Health Related Fitness Parameters in Women

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Abstract

The effects of high intensity functional training (HIFT) on health related components of fitness and quality of life were studied in the gym environment, but there has not been any study on examining the effects of HIFT by using bodyweight exercises at home environment on health related components of fitness and quality of life in women. The goal of this research is to examine the effects of home-based bodyweight HIFT on health related components of physical fitness and quality of life in women. Twenty-one recreationally active female participants (age 26.3 ± 3.7 years) were included in the study. After completing the pretest, participants applied HIFT at home with bodyweight exercises three times a week for a duration of eight weeks. Cardiovascular endurance, muscular strength, muscular endurance, flexibility, body composition and quality of life assessments were carried out in both pretest and posttest applications. Significant differences were observed between the pretest and posttest results of cardiovascular endurance (p=0.042), muscular strength (p<0.001), muscular endurance (p<0.001) and flexibility (p=0.001) parameters. No significant difference was observed between the pretest and posttest results of body composition analysis. Significant improvement (p=0.045) was found on the quality of life scale. Home-based bodyweight HIFT altered quality of life in recreationally active women and enhanced health related components of fitness, which could prevent the increase of health-related risk factors caused by inactivity.
Keywords: Health related fitness, HIFT, Home based training, Bodyweight exercises, Quality of life

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INTRODUCTION

Effects of inactivity on health related components of fitness and their correlation with cardiovascular risk elements have found to be detrimental (Narici et al., 2020; Perrone et al., 2021). According to the study of Mulder and others (2015), only 5 days of inactivity caused an 8-9% decrease in quadriceps muscle strength, and 6% atrophy occurred following 10 days of inactivity (Narici et al., 2020). Saltin and colleagues (1968), who had important studies on human physiology, revealed that after 20 days of inactivity, the maximum oxygen consumption of young and healthy individuals decreased by 28% and stroke volume decreased by an average of 11%. When the maximum oxygen consumption, which is one of the most important parameters of health, decreased by one MET (3.5 ml/kg/min), the prevalence of cardiovascular diseases increased by 18% and mortality by 15% (Kodama et al., 2009). Conversely, each MET increase in maximum oxygen consumption resulted in decrease of 11.6%, 16.1%, and 14.0% in all-cause deaths, cardiovascular disease-related deaths, and cancer-related deaths, respectively (Imboden et al., 2018). World Health Organization (2020) recommended engaging in at least 150 minutes of moderate intensity exercise per week, 75 minutes of vigorous exercise per week or a combination of both and stated that the recommendation could also be applied at home environment.

Health-related components of fitness, which include cardiovascular endurance, muscular endurance, muscular strength, flexibility and body composition (Caspersen et al., 1985), were all found to be positively related with quality of life. In the study conducted by Ogwumike et al. (2011), a significant increase in participants' quality of life was observed following 12 weeks of cardiovascular endurance training. Shoup et al., (1997) investigated the impact of body composition on quality of life and found that individuals with a healthy weight had higher health-related quality of life scores compared to those who were underweight or overweight. In addition, Porciúncula-Frenzel et al., (2013) discovered that women of normal weight scored higher in the physical health section of the World Health Organization Quality of Life Scale compared to overweight women. Cunningham et al., (1993) revealed that muscular strength, muscular endurance, and flexibility levels were positively correlated with quality of life, particularly among the older adults.

Time constraints and the lack of time to go to the gym are major factors that prevent the majority of the population from engaging in physical activity (Hollingsworth et al., 2020). Home-based bodyweight functional exercises are suitable alternatives for individuals who cannot go to the gym for various reasons (McDermott, 2017). While free weights and machines are commonly emphasized in resistance training, Sperlich et al., (2017) have revealed that effective resistance training can also be achieved using only bodyweight; exercises performed with bodyweight by applying a high-intensity circuit training model, have been found to enhance both cardiovascular endurance and functional strength.

High intensity functional training (HIFT) involves multi-joint exercises performed at high intensity that might or might not include rest periods between exercises (Feito et al., 2018). When bodyweight resistance training is performed by using the HIFT method, it takes less time than traditional resistance training and can be done in any environment since it requires no equipment, making it more suitable for individuals who are unable to go to the gym due to time constraints (Haddock et al., 2016). According to the literature (Feito et al., 2018; Heinrich et al., 2015), conventional aerobic exercises do not provide adequate strength development, while conventional strength exercises do not provide sufficient cardiovascular benefits; HIFT aims to develop both of these components at the same training session in optimal time with circuit training model applied at high intensity.

In the literature, the effects of HIFT on health related fitness components and quality of life were studied in the gym environment (Sperlich et al., 2017), but there has not been any study on examining the effects of HIFT by using bodyweight exercises at home environment on health related components of fitness and quality of life. This study aimed to investigate the effects of home-based bodyweight HIFT on health related fitness components and quality of life in recreationally active women.

METHOD

Research Model

This study employed an experimental, non-randomized one group pretest-posttest design. Participants of the study were selected by convenience sampling method. The decision to employ convenience sampling was influenced by the limited availability of recruiting participants. Given that participants recruited for this study were personal fitness clients of the researcher, and considering the limited number of clients available during the intervention period, a control group was not incorporated into the study.

Research Group

Participants were members of a fitness club in Istanbul, Turkey. 21 recreationally active female participants between the ages of 18-35 were included in the current study (26.3 ± 3.7 years, 57.7 ± 4.6 kg). Participants did not have any cardiovascular or neuromuscular health problems and declared that they have doctor's approval for exercising at high intensity. Participants were informed about the study's content, and written consent was obtained from each individual.

Ethical Approval

Ethics Committee of the School of Medicine, Marmara University approved this study. The research was carried out in compliance the Declaration of Helsinki.

Study Design

The design of the study is shown in Figure 1.

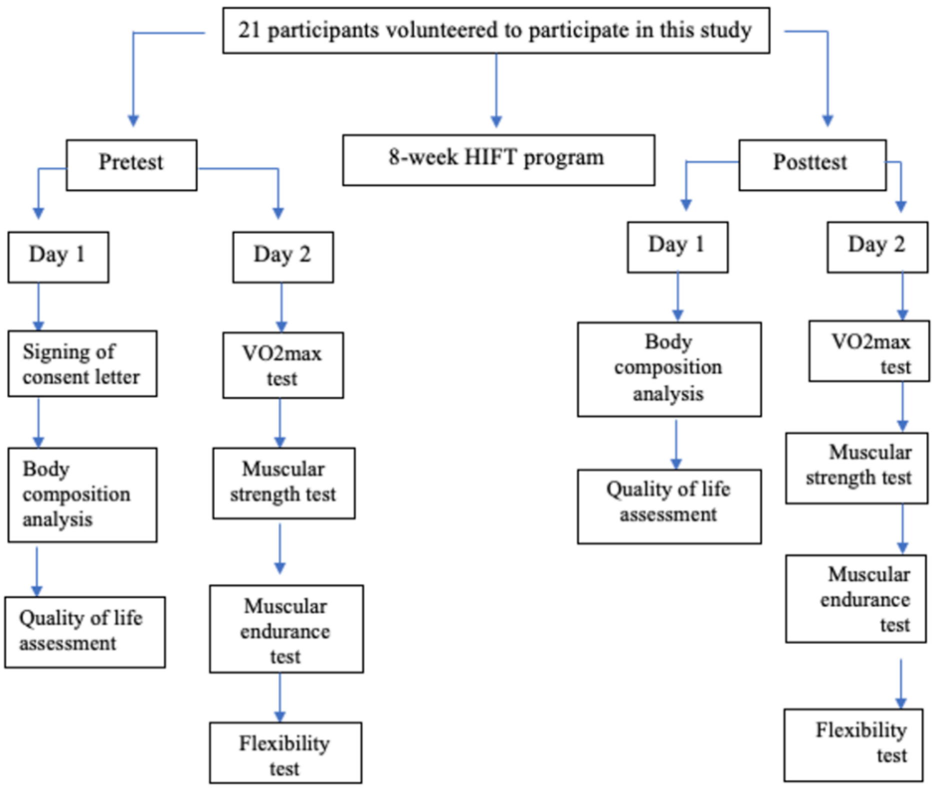

Figure 1. Design flowchart

Following the pretests and the implementation of the 8-week workout routine, posttests were conducted to evaluate the changes in body composition, cardiovascular endurance, muscular strength, muscular endurance, flexibility, and quality of life.

Body Composition Analysis

Body composition values of the participants were analyzed by using bioelectric impedance analysis (Tanita BC-418, Japan). Height information was entered into the device after measuring the height of the participants with a stadiometer. Participants did not consume food or drink for four hours, did not perform any activity that may cause dehydration for 12 hours, did not drink alcohol or caffeine for 12 hours before the tests (Ritchie et al., 2005).

Cardiovascular Endurance Test

Cardiovascular endurance test was applied to the participants by using Rockport Walk Test on treadmill in order to calculate VO2max values indirectly. After a 10 minute standard warm-up, participants were instructed to walk for 1.6 km on treadmill as fast as possible and VO2max values were calculated indirectly by Rockport formula (Kline et al., 1987).

Muscular Strength Test

Muscular strength test was applied to the participants by indirectly measuring their one repetition maximum weight (RM) in chest press and leg press exercises; 6RM was measured to calculate 1RM indirectly to minimize the risk of injury during pretest and posttest applications. First, participants performed six repetitions with their estimated 10RM on chest press machine and gradually increased the load until they reached 6RM; three minutes of rest was given between each attempt. 6RM is approximately 85% of 1RM (Morales & Sabonya), so participants' 1RM is calculated indirectly by dividing their 6RM to 0.85. The same procedures were applied on the leg press exercise. Muscular strength score of each participant was recorded as the average 1RM of chest press and leg press exercises: [(Chest Press 1RM+ Leg Press 1RM) / 2].

Muscular Endurance Test

Muscular endurance test was conducted as participants performed maximum number of repetitions on chest press and leg press machines by using 40% of their calculated 1RM for each exercise (American College of Sports Medicine, 2009). Muscular endurance score of each participant was evaluated as the average number of repetitions performed on chest press and leg press exercises: [(Chest Press Maximum Repetitions + Leg Press Maximum Repetitions) / 2].

Flexibility Test

Flexibility test was applied to the participants by using sit and reach test. Participants reached forward as far as possible on sit and reach box by using both hands without bending their knees; flexibility score was recorded at the farthest point of two attempts (Crotti et al., 2018).

Quality of Life Assessment

Quality of life assessment of the participants was carried out by using World Health Organization Quality of Life Scale (WHOQOL-BREF). In this scale, which had 26 questions in total, physical, psychological, social and environmental domains were scored as four different parameters and the participants' quality of life score were determined by the average score of these domains (World Health Organization, 1998).

Eight-Week HIFT Program

Eight-week home-based bodyweight HIFT program was constructed for the participants. Three training sessions were completed each week for eight weeks with a minimum of 48 hours between workouts. Each participant completed their training sessions individually at home environment, filled out training log during each workout, recorded heart rate data by using heart rate monitor and sent training information to the researcher online after each workout. Training data for each participant had been tracked by the researcher and saved for further analysis. The training program has been prepared by the researchers according to the basic principles of HIFT (Feito et al., 2018), details of the eight-week HIFT program are as follows:

- Warm-up circuit included 30 repetitions of jumping jacks, 20 seconds of plank, 10 repetitions of squats, and five repetitions of burpees. Three sets were performed for each circuit without a defined rest period between sets.
- Each training set included one minute of squat jumps, one minute of alternate reverse lunges, one minute of burpees, one minute of sit-ups, and one minute of back extensions. A total of six sets were performed without a defined rest period between sets (30 minutes in total).
- Cool-down section included static stretching exercises for the upper and lower extremities.

Participants were already familiarized with the correct form of the exercises that are in the eight-week HIFT program because they had already been recreationally active; nevertheless, correct form of each exercise in the training program was shown to the participants prior to the training period. Instructions given to the participants for training sessions are as follows:

The rest period between sets are not defined due to the characteristics of HIFT, the transition between exercises should be done as fast as possible. In case of reaching exhaustion before completing the set in any exercise, the minimum possible amount of time should be used to rest, then the participants must continue their effort in order to finish the highest number of repetitions achievable in the remaining time. The goal of each workout is to do more total repetitions than the previous workout which is recorded in the training log. Rating of perceived exertion (RPE) and heart rate data must be written by the participants on the training log at the end of each workout. Training intensity is expected to above RPE 15, and above 75% of the maximum heart rate (HRmax).

RPE and heart rate data at the end of each workout were examined by the researcher. Participants who failed to stay above 75% HRmax throughout the workout were obligated to redo the workout during the same week.

Analysis of Data

The statistical analysis for the study was conducted using the IBM SPSS Statistics 28 software. The maximum, minimum, mean and standard deviation values of the descriptive statistics, pretest and posttest scores were calculated by standard statistical methods. The distributions of the variables were analyzed for possible outliers. Univariate outliers were identified as scores that deviated more than 3 standard deviations from the mean. The comparison of pretest and posttest data was evaluated by using Wilcoxon signed rank test. The significance level used during the entire study was 0.05.

FINDINGS

Minimum, maximum, mean and standard deviation values of each parameter were analysed; no univariate outliers were revealed.

Cardiovascular endurance, muscular endurance, muscular strength, flexibility pretest and posttest data are given in Table 1.

Table 1. Health-related components of fitness excluding body composition

Variables	N	Pretest (M ± SD)	Posttest (M ± SD)	Z	p
Cardiovascular Endurance (ml/kg/min)	21	40.84 ± 4.75	42.02 ± 4.22	-2.03	**0.042***
Muscular Strength (kg)	21	41 ± 8.2	49.1 ± 10.2	-4.03	**<0.001***
Muscular Endurance (reps)	21	41.6 ± 10.5	54 ± 11	-4.02	**<0.001***
Flexibility (cm)	21	9.2 ± 8.9	11 ± 8.5	-3.41	**0.001***

$^*p<0.05$

Eight weeks of home-based bodyweight HIFT induced significant enhancements in cardiovascular endurance (p=0.042), muscular strength (p<0.001), muscular endurance (p<0.001) and flexibility (p=0.001) parameters of the participants. The body composition analysis data for the pretest and posttest are presented in Table 2.

Table 2. Body composition analysis pretest and posttest data

Variables	N	Pretest (M ± SD)	Posttest (M ± SD)	Z	p
Bodyweight (kg)	21	58.51 ± 7.91	58.83 ± 7.63	-1.438	0.150
Fat mass (kg)	21	15 ± 6.70	15.17 ± 6.24	-0.654	0.513
Fat free mass (kg)	21	43.53 ± 2.92	43.67 ± 2.86	-0.435	0.664
Body fat ratio (%)	21	24.73 ± 7.78	25.01 ± 7.16	-0.435	0.664

No statistically significant change (p>0.05) was found in any component of body composition. WHOQOL-BREF data for the pretest and posttest are presented in Table 3.

Table 3. WHOQOL-BREF pretest and posttest data

Variables	N	Pretest (M ± SD)	Posttest (M ± SD)	Z	p
Physical domain score	21	76 ± 12.6	81 ± 12.7	-2.44	**0.015***
Psychological domain score	21	74 ± 13	76 ± 13.6	-1.43	0.154
Social domain score	21	78 ± 14.9	80 ± 15	-0.63	0.531
Environmental domain score	21	69 ± 15.4	72 ± 13.5	-1.7	0.089
Quality of life score	21	74 ± 11.3	77.5 ± 12	-2.01	**0.045***

***p<0.05**

Significant improvement (p=0.045) was found in the quality of life scale. Among the four sub domains of WHOQOL-BREF, significant difference (p=0.011) was only found in the physical domain of the scale.

DISCUSSION and CONCLUSION

Research in the literature about the impact of HIFT on body composition in recreationally active women are examined and compared to our study. In the study conducted by Kapsis et al., (2022) on 22 female and 19 male recreationally active participants, three groups were formed as low load, medium load and control groups. Participants in the low load and the medium load groups applied HIFT three sessions per week for 12 weeks in the gym environment; the low load group performed resistance exercises with 30% of their 1RM and the medium load group performed resistance exercises with 70% of their 1RM.

At the end of sixth week, the mean percentage of body fat for both low load and medium load groups decreased significantly, but only the low load group experienced a highly significant decrease in the mean body fat percentage between 6th and 12th weeks. Although the training volumes (load x repetitions) of both groups were similar, the difference among the groups was attributed to the fact that the low load group did more repetitions of each exercise compared to the medium load group, and fat burning process improves at higher repetitions in HIFT workouts. In addition, participants' diet was monitored by the researcher in the aforementioned study. In our study, no significant change was observed in the percentage of the body fat of the participants by the end of eight week even though our participants applied HIFT with high repetition bodyweight exercises; this result could be explained by not monitoring the diet of the participants unlike Kapsis and colleagues. In the research of Kapsis et al. (2022), only the medium load group experienced a significant increase in lean body mass at the end of sixth week while both goups experienced significant increase in lean body mass at the end of 12th week, which was attributed to the fact that neural adaptations take place earlier compared to the hypertrophy of the muscle; during the first 6 weeks, 70% of 1RM load was high enough to stimulate hypertrophy while it took more time for the low load group to experience significant hypertrophy. In our study, no significant increase was observed in lean body mass at the end of the eight week eventhough the muscular strength and muscular endurance parameters improved significantly; this is an indication that the participants developed sufficient neural adaptation but not sufficient hypertrophy at the end of eight-week period. The reason for this result could be explained by the load of resistance in our HIFT program which was consisted of bodyweight exercises; significant hypertrophy was not achieved by HIFT performed at this load in recreationally active women in 8-week period. The study of Lipecki and Rutowicz (2015) supports this view; 10-week bodyweight HIFT program was applied to 15 women between the ages of 21-23; even though significant improvements were observed in the muscular strength and muscular endurance tests after 10-week period, no significant difference was noted in body fat percentage or lean mass. This result was associated with the fact that the researcher did not monitor the diet of the participants, and the resistance exercises performed at bodyweight did not produce sufficient hypertrophy within 10 weeks.

In the literature, there are also studies related to our topic in which the diets of the participants were not monitored by the researcher and significant changes were observed in body composition values; in Clark's study (2014), nine female and four male recreationally active participants applied the P90X program, a HIFT training method, for four weeks by using bodyweight and minimum equipment at home environment. A significant decrease was observed in the mean body fat percentage of the participants by the end of four weeks, while no significant difference was observed in bodyweight which indirectly indicates the increase of lean body mass in four-week period. In the study of Sobrero et al. (2017), 19 recreationally active female participants were separated into two groups as HIFT group and traditional circuit training group; the participants were given exercises that require both bodyweight and external weights in the gym environment. After the training period of six weeks, the mean bodyweight of the HIFT group increased significantly while a significant decrease was observed in the mean body fat percentage. The discrepancies between the findings of these studies and our study could be explained by the fact that bodyweight HIFT might not produce sufficient hypertrophy in eight weeks compared to HIFT by using external weights or equipment.

There have been many studies in the literature stating that HIFT provides significant improvements on cardiovascular endurance: in the study of Murawska-Cialowicz et al. (2015), five female and seven male recreationally active participants applied HIFT by using both bodyweight and external weights two sessions per week for three months at a Crossfit gym. At the end of three months, the average VO2max of the female participants increased significantly.

In the study of Buckley et al. (2015), 28 recreationally active female participants applied HIFT by using both bodyweight and external weights in the gym environment three sessions per week for six weeks; the average VO2max of the participants improved significantly. In the study of McRae et al., (2012) on 22 recreationally active women, participants applied HIFT by using bodyweight and minimum equipment four sessions per week for four weeks; the mean VO2max of the group significantly increased. Information about the location of the training sessions in the aforementioned study was not given, but the researcher stated that HIFT can be performed at home by using bodyweight and minimum equipment. In our study, the participants applied bodyweight HIFT at home for eight weeks; the mean value of VO2max increased significantly from 40.84 ml/kg/min to 42.02 ml/kg/min. According to these results, applying bodyweight HIFT at home on recreationally active women produces similar results in terms of cardiovascular endurance development compared to applying HIFT with external weigths or equipment.

Various studies examining the impacts of HIFT on muscular strength are available in the literature: In the study of Posnakidis et al. (2022), eight female and five male physically active participants applied HIFT in the gym environment by using both bodyweight and external weights three sessions per week for eight weeks. By the end of the study, highly significant improvements were observed in muscular strength of the participants. In the study of Kliszczewicz et al. (2019), HIFT was applied to 10 female and 10 male recreationally active participants for four weeks by using both bodyweight and external weights in the gym environment; significant enhancements were observed in muscular strength of the participants. As an example of a longer study, in the study of Feito et al. (2018), 17 female and 9 male recreationally active participants applied HIFT by using both bodyweight and external weights in the gym environment at least two days per week for 16 weeks; significant enhancements were observed in muscular strength of the participants. In our study, highly significant improvements were observed in muscular strength of the participants who applied home-based bodyweight HIFT for eight weeks. These findings reveal that applying bodyweight HIFT at home environment and applying HIFT by using external weights or equipment in the gym environment can produce similar results in muscular strength parameter of recreationally active women. The only study in the literature which states that HIFT does not improve muscular strength in recreationally active women is the study of McRae et al. (2012); the reason for this result could be explained by the application of the grip strength test as the indicator of muscular strength instead of tests that involve large muscle groups in the lower and upper extremities.

According to our knowledge, all of the studies in the literature examining the impacts of HIFT on muscular endurance in women have revealed that HIFT provides significant improvements in this parameter. In the study conducted by Barfield et al. (2012) on 15 female and 45 male recreationally active university students, the Crossfit group applied HIFT by using both bodyweight and external weights in the gym environment two days per week throughout a school semester; significant improvements were observed in muscular endurance of the participants. In the studies of Posnakidis et al. (2022), Sobrero et al. (2017), and Buckley et al. (2015), participants applied HIFT three sessions per week by using both bodyweight and external weights in the gym environment for eight weeks, six weeks, and six weeks respectively; significant improvements were observed in muscular endurance of the participants in all of these studies. In our study, a highly significant improvement was observed between the pretest and posttest results of muscular endurance of the participants who applied home-based bodyweight HIFT for eight weeks; our findings are consistent with the studies in which HIFT workouts were applied in the gym environment by using external weights, which reveal that the application of bodyweight HIFT at home environment can lead to similar improvements in muscular endurance compared to the application of HIFT in the gym environment by using external weights in recreationally active women.

There are contradictive findings in the literature about the effects of HIFT on flexibility in recreationally active women; in the research of Cosgrove et al. (2019), 23 female and 22 male recreationally active participants were seperated in two groups according to their HIFT history as "0-6 months group" and "+7 months group". The participants applied HIFT by using both bodyweight and external weights for six months in a Crossfit gym, four sessions per week on average; significant improvements were observed in sit and reach flexibility test results of the participants in both groups. In the aforementioned study, the participants also applied stretching exercises in the five-minute cool-down section of their workouts, but the improvements in flexibility were not associated with stretching exercises by the researcher. In the study of Sobrero et al. (2017), which is an example of a shorter duration research compared to the study of Cosgrove et al. (2019), no significant changes were detected in the sit and reach flexibility test results of the participants who performed HIFT for six weeks; it was also stated that the participants applied stretching exercises in the cool-down section of their workouts. In our study, a highly significant improvement was observed between the sit and reach flexibility pretest and posttest results of the participants. Throughout our study, the participants applied static stretching exercises in the cool-down section of the workouts; therefore, it is unknown whether the real reason for the improvement in flexibility score was due to HIFT workouts or static stretching exercises. As a result of the contradictory findings in our study and the literature, the effects of HIFT on flexibility cannot be interpreted clearly.

There is limited research in the literature on the effect of HIFT on quality of life. In the study of Engel et al., (2019) on 10 female and 10 male recreationally active participants, an 8-week HIFT program was applied to the participants; no significant change was observed in any parameter of WHOQOL-BREF. Contrary to this study, Sperlich et al.'s studies on overweight women in 2017 and on sedentary women in 2018 showed significant improvements in SF-36 Quality of Life Scale (Bullinger et al., 2008) in women who performed HIFT for nine weeks and four weeks, respectively. The reason for the difference in the findings of these studies can be explained as the responses given to exercise in overweight and sedentary women could be higher than in women who are recreationally active. However, in our study, statistically significant improvement was found on the quality of life and the physical domain of the scale.

The impacts of HIFT on health-related components of fitness and quality of life were previously studied in the gym environment, but this study was the first to investigate the effects of bodyweight HIFT at home environment on health related components of fitness and quality of life in women. Home-based bodyweight HIFT for eight weeks provided significant improvements in cardiovascular endurance, muscular endurance, muscular strength, flexibility and quality of life in recreationally active women, which could help prevent the increase of health-related risk factors caused by inactivity.

Based on the results of this study, suggestions for future research on the effects of HIFT are as follows:

- Future research can be applied by monitoring the diet of the participants' during the training period.

- Future studies aiming to examine the effects of HIFT on flexibility can be conducted without stretching exercises at the end of training units.

- Future studies should include a control group to evaluate the effects of home-based HIFT on health-related fitness components; the absence of a control group was a major limitation of this research.

Conflicts of Interest: The authors declare that no financial or personal conflict of interests have influenced the research and findings presented in this study.

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Ethical Approval

Ethics Committee: The Ethics Committee of the Department of Medicine, Marmara University

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