

Anthropometric Parameters and Physical Fitness in Marathon Participants with a History of Heart Disease- An Observational Study

Abstract

Marathon training is a popular strategy used in cardiac rehabilitation. It may have a role in reducing the risk factors for cardiovascular disease.

Purpose: The aim of the study was to observe the anthropometric parameters and physical fitness in older adults with a history of heart disease and receiving Marathon training as a rehabilitation therapy.

Methods: A multi-centered study was carried out to assess the anthropometric parameters and physical fitness levels in male half marathoners with and without a history of heart disease (Group 1 and 3 respectively). A group of non-marathoners with a history of heart disease was selected as a control group (Group 2). Anthropometric parameters and physical fitness (flexibility and VO_2 max) was assessed for all groups.

Results: The weight across the three groups were similar. There was a significant difference ($p \leq 0.05$) in mean age, height, waist circumference, WHR, total fat % and skeletal muscle % across the 3 groups. All the subjects across the groups were involved in moderate to high intensity aerobic as well as resistance activity for 3 times in a week. The mean waist circumference was found to be more among subjects with history of heart disease as compared to normal range, but a reduced value was observed in mean WHR across the groups. Mean visceral fat an indicator of cardiovascular risks, was found to be high across the groups. According to the mean body fat %, the non-marathoners fell under overweight range and as per the BMI they fell under obese category. All half marathoners (Group 1 and 3) showed mean BMI in overweight range however, the body fat % was found to be within acceptable limits. This indicates a higher muscle mass and therefore, better body composition in group 1 and 3. Mean flexibility was found to be significantly different ($p = 0.032$) across the groups. Majority of the subjects showed poor flexibility, however, 21% of half marathoners showed good flexibility. There was also a significant difference in VO_2 max level ($p = 0.00$) between half marathoners with and without a history of heart disease as subjects without a history of heart disease showed better VO_2 max level as compared to subjects with history of heart disease.

Conclusion: Training strategies used in marathon training can be used to prevent the rising risks for cardiovascular disease in India. Further studies are warranted in this area.

Keywords: Marathon; Half marathon cardiovascular benefits; CVD risk; Visceral fat

Research Article

Volume 6 Issue 3 - 2017

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Received: December 19, 2016 | **Published:** March 03, 2017

Abbreviations: CVD: Cardiovascular; WHR: Waist to Hip Ratio; BIA: Bioelectrical Impedance Analysis; BMI: Body Mass Index

Introduction

Aging leads to changes in the mechanical and structural properties of the vascular wall, which leads to the loss of arterial elasticity and reduced arterial compliance and may subsequently lead to an increased risk for coronary artery disease [1]. Post a cardiac event most patients are referred for a cardiac

rehabilitation program. Cardiac rehabilitation programs usually have a multidisciplinary approach and provides education and counselling services to help heart patients increase physical fitness, reduce cardiac risk factors, improve health and reduce the risk of another cardiac in future [2].

Many cardiovascular disease patients are remarkably unfit because of illness and inactivity. They can often achieve considerable improvements in exercise capacity from even low-level exercise training [3]. Resistance training has not been studied

extensively in cardiac patients, but some studies suggest that it increases the ability to perform household tasks in frail women with Coronary Artery Disease (CAD) [4]. This may help improve quality of life in older adults. The benefits of half marathon training on anthropometric parameters and fitness levels are not sufficiently studied. High intensity-short duration endurance training for 30 minutes can cause significant improvement in aerobic fitness [5].

Materials and Methods

The study aim was to observe the anthropometric parameters such as body composition, WHR and physical fitness levels in older adults aged 45 to 65 years with a history of heart disease and receiving marathon training as a rehabilitation therapy. It was a multi centered study, carried out in various centers in Mumbai viz., You too can run sports management Pvt. Ltd., Mumbai, Qi Lifecare, Mumbai and Topgear MIG Bandra and Runners Academy, Mumbai. The 45 subjects were divided into 3 groups; Group 1= 15 male half marathoners with history of heart disease, Group 2=15 male non-marathoners with history of heart disease and Group 3= 15 male half marathoners without a history of heart disease. Subjects in groups 1 and 3 were half marathoners with and without a history of heart disease (CABG surgery, Angioplasty and Angiography) respectively. While subjects in group 2 were non-marathoners with a history of heart disease. Females subjects and subjects below age 45 and above age 75 years were excluded from the study. It was ensured that the subjects did not suffer from any active ailment/medical condition at the time of the study. Research assistant explained the study in full detail to the subjects and obtained a written consent. After receiving the written consent, the anthropometric parameters were measured and fitness tests were performed (Figure 1).

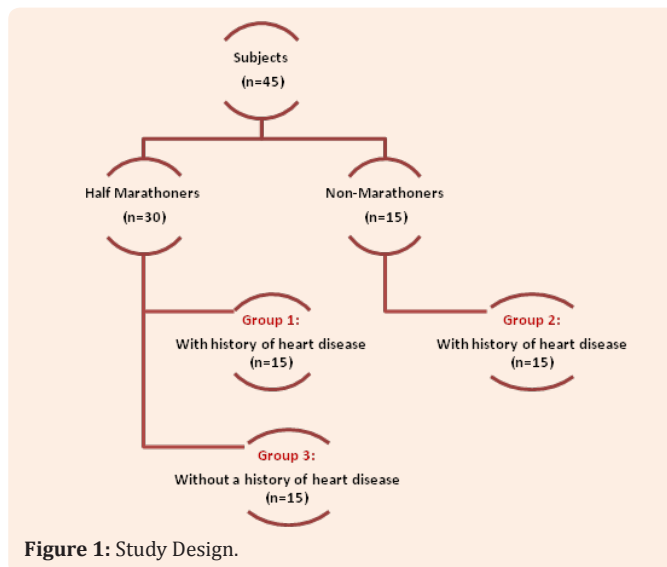


Figure 1: Study Design.

Demographic information

The demographic information of the subjects as shown in Table 1 was collected at the beginning of the study. The anthropometric parameters studied were as follows:

Anthropometric measurements: Anthropometric measurements were used to compare the body composition of the participants across three groups. It is an established fact that higher body fat percentage and visceral fat is associated with metabolic and cardiovascular disease risk.

Height, weight and BMI (Body Mass Index): Height measurements in cm using a calibrated height scale and weight measurements in kg using an Omron HBF 375 weighing scale were taken. BMI was calculated as per BMI = (weight in kg)/(height in m²) equation. Based on the BMI classification for Asian Indians, the subjects were screened for their weight categories.

Waist and Hip circumference and Waist to Hip ratio (WHR): Waist and Hip circumference measurements were recorded in inches using flexible non-stretchable measuring tape. Waist to Hip Ratio (WHR) was calculated as WHR= (waist circumference in inches)/ (hip circumference in inches). Waist circumference and WHR is a predictor of cardiovascular disease it associated risk factors.

Bioelectrical Impedance Analysis (BIA): The Omron HBF 375 was used to assess skeletal muscle (%), visceral fat (%), subcutaneous fat (%) and total fat (%). Measurements were made in the morning before, the training for marathon began. Subjects were informed not to drink plenty of water or caffeinated drinks 4 hours prior to the appointment.

Fitness Assessments

Fitness assessments focused on the flexibility cardiovascular fitness and aerobic endurance. It is important people who run half marathons have good strength, flexibility and cardiovascular fitness. On the other hand, training for half marathon, may help an individual improve on these fitness aspects. Various cardiac rehabilitation centers use strategies of marathon training to help improve and enhance the physical fitness in patients post a cardiac event.

Flexibility test- (YMCA sit and reach test)

Modified Sit and Reach Test as per the YMCA protocol was used to assess the lower back and hamstring flexibility in the subjects. Subjects were asked to warm up for 5 minutes and then made to sit on the floor (leveled surface) with legs apart (about 1 feet apart). Measuring tape was placed in between the legs keeping 14 inches between the heels of the foot. Subjects were asked to flex and then slide their hands over the tape gradually without jerking their body. The flexibility was measured in inches on the tape fixed in between the legs [6].

VO₂ max measurements

VO₂ max refers to the maximum amount of oxygen that an individual can utilize during intense or maximal exercise and is expressed as ml/kg/min. For half marathoners, Davies-Thompson table was used to compute the VO₂ max. Davies-Thompson table predicts VO₂ max for equivalent running time (h:min:sec) covering 21 km. Subject's running time was noted, based on which the VO₂ max was determined. Whereas for non-marathoners the Rockport 1 mile walk test was used to compute the VO₂ max. Rockport 1

mile walk test was performed on a treadmill at the Cardiac Rehabilitation Centre- Qi lifecare, Churchgate, Mumbai. Time (min:sec) required to complete 1 mile walk or 1.6 km walk were recorded along with the heart rate (beats per minute) post the completion of the walk. VO₂ max was then determined using the following formula-

$$VO_2 \text{ max (ml/kg/min)} = 132.853 - (0.0769 \times \text{weight in kgs}) - (0.3877 \times \text{age in years}) + (6.315 \times \text{gender}) - (3.2649 \times \text{time}) - (0.1565 \times \text{Heart rate})$$

Gender: male = 1; female = 0

Table 1: Demographic Information of the subjects.

	Group 1	Group 2	Group 3	Significance
Number	N=15	N=15	N=15	-
Description & Inclusion Criteria	Male half marathoners with a history of heart disease, Aged 45-65 years, Males	Male non-marathoners with a history of heart disease, Aged 45-65 years, Males	Male half marathoners without a history of heart disease, Aged 45-65 years, Males	-
Age (yrs)	61.27±7.44	61.6±7.24	52.2±7.22	*0.001
Height (csm)	166.6±7.20	164.13±7.99	172.07±5.48	*0.010
Weight (kg)	70.6±9.54	72.12±11.03	72.71±11.97	0.862
BMI (kg/m ²)	25.67±3.23	26.66±2.99	24.52±3.64	0.217
Year the heart surgery was conducted	2007-2013	2006-2015	-	-
Average half marathons participated	2-27	-	1-35	-
Average time taken for 21 km	02:19:07- 03:41:18	-	01:50:02- 02:59:52	-

*level of significance: p ≤ 0.05

Statistical Analysis

The data on body composition, anthropometric and fitness level were analyzed using SPSS 16.0 version. The data analysis was performed on 3 groups comparatively. ANOVA test was applied to the data.

Results and Discussion

The observational study was conducted between June, 2015 to March, 2016. The sampling used was purposive sampling and the centers were chosen based on expertise to train patients with and without a history of heart disease for half marathons. All subjects coincidentally were males. The demographic characteristics of the participants in the three groups is mentioned in Table 1.

Anthropometric measurements

The average starting weight for the subjects were similar hence the subjects could be compared for other fitness parameters. All subjects on marathon training had similar training schedules. Majority of subjects (60% in group 1; 67% in group 2 and 47% in group 3) fell under obese category with BMI >25 kg/m². Around 13% in group 1, 20% in group 2 and 33% in group 3

were in overweight category (BMI= 23 to 24.9 kg/m²) according to the WHO BMI category for Asian Indians. The mean BMI was lower for group 3 as compared to 1 and 2 and had less number of subjects falling in the obese category. This indicates that the risk for cardiovascular disease based on BMI ranges, was lower in group 3 viz., half marathoners who had no history of heart disease so far.

WHR is an important predictor of incident CVD [7]. While, waist circumference is a more sensitive index than BMI for identifying the presence of one or more vascular risk factors. There was significant difference in the mean waist circumference and WHR among all 3 groups. Non-marathoners showed higher waist circumference (87%) and WHR (27%) whereas Half marathoners with and without a history of heart disease showed lesser waist circumference (60% & 47% respectively) and WHR (20% in both). This confirms that structured physical activity, such as training for half marathon can help reduce waist circumference and thereby, offer cardioprotective benefits.

Body composition was assessed using Omron HBF35. Mean visceral fat was high across the groups. Mean body fat % was found to be acceptable (18.01-25.99%) among half marathoners

while non-marathoners fell under overweight category (26.01-37.99%). There was significant difference in mean skeletal muscle across the group. However, half-marathoners without history of heart disease showed higher skeletal muscle than the normal range. Table 2 shows that half marathon training can significantly increase the metabolically active skeletal muscle, reduce total fat %, waist circumference and WHR ($p \leq 0.05$).

Physical fitness assessment

The goals of cardiac rehabilitation using strategies of training for half marathon are increasing the vascularity of the myocardium, improve HDL cholesterol, improve glucose tolerance and insulin sensitivity, weight management and reduction in blood pressure. The training schedule across the 3 groups is shown in Table 3.

Table 2: Anthropometric Measurements of Subjects (n=15 in each group).

Variables	Group 1 Mean±SD	Group 2 Mean±SD	Group 3 Mean±SD	P Value
Waist circumference (inches)	37±3.74	39±3.66	34.53±3.16	*0.005
Waist to hip ratio (WHR)	0.92±0.09	0.95±0.05	0.88±0.07	*0.054
Total fat %	25.97±4.14	30.13±4.01	24.24±4.74	*0.002
Visceral fat %	13.67±4.94	14.49±5.76	11±4.69	0.165
Subcutaneous fat %	20.35±2.80	22.06±3.32	19.19±3.24	0.065
Skeletal muscle %	27.32±1.84	25.53±3.29	28.38±3.66	*0.043

*level of significance: $p \leq 0.05$

Table 3: Training schedule across the 3 groups (n=15 in each group).

	Training/Practice	Form of Exercise	Activity Apart from Training Center
Half marathoners with a history of heart disease (Group 1)	You Too Can Run Sports Management Pvt. Ltd.	(3 times a week; 1 and a half an hour at 85% MHR) running practice, static & dynamic stretches, core & back strengthening, yoga asanas, memory game and posture correction	None
Non-marathoners with a history of heart disease (Group 2)	Qi Lifecare's Cardiac rehabilitation center	(3 times a week) aerobic exercises, resistance exercises, core & back strengthening and regularly heart rate monitoring	- 60% early morning walk every alternate day (30 mins) - about 13% involved in yoga for 3 times in a week.
Half marathoner without a history of heart disease (Group 3)	Topgear MIG Bandra & Runners Academy	(3 times a week) running practice, running drills, dynamic stretches, core & back strengthening and yoga asanas	About 13% subjects also exercised in a gym (1 hr. 15 mins at high intensity) and squash (3 times a week)

As shown in table 3, all the subjects involved in moderate to high intensity aerobic as well as resistance activity for 3 times in a week. Endurance training induces greater improvements in aerobic capacity and associated cardiopulmonary and metabolic variables and more effectively modifies cardiovascular risk factors. Resistance training enhances muscular strength, endurance, and muscle mass.

Flexibility was assessed across the groups using YMCA sit and reach technique and was found to be significantly different ($p = 0.032$). Majority of the subjects showed poor flexibility. However, across the 3 groups, 27% of half marathoners (Group 1 and 3) showed good flexibility. Also, since half marathoners focus more on their aerobic fitness, there is a possibility they emphasize less

on flexibility training. Age factor could also be a possible cause for poor flexibility in the subjects.

VO_2 max level of non-marathoners cannot be compared with half marathoners as method used to assess VO_2 max for the two groups was different. For Half marathoners with and without a history of heart disease (Group 1 and 3), VO_2 max was computed using Davies-Thompson method. There is significant difference in VO_2 max level ($p = 0.00$) between half marathoners with and without a history of heart disease. Among half marathoners, about 20% subjects without a history of heart disease (Group 3) showed good to excellent VO_2 max level. However, very poor VO_2 max level (67%) was observed in the subjects with a history of heart disease (Group 1). For non-marathoners with a history of

heart disease (Group 2), VO_2 max was computed using Rockport 1 mile walk test. 60% subjects showed very poor VO_2 max level whereas only 13% subjects showed good level of VO_2 max. This could be a result of not indulging in much of regular physical activity in addition to the cardiac rehabilitation.

Conclusion

Training for half marathon can significantly improve skeletal muscle mass, reduce total body fat %, visceral fat, waist circumference and WHR in people with and without history of heart disease. In fact, the training ensues very similar visceral fat, total body fat and skeletal muscle in both the groups. However, the waist circumference and WHR is higher in half marathoners with a history of heart disease than those without a history of heart disease. Training strategies used to prepare for half marathon can be used to reduce the incidence of cardiovascular diseases in India.

Acknowledgement

The authors would like to thank Mr. Venkatraman Pichumani, Founder and Owner at You Too Can Run Sports Management Pvt. Ltd., Mumbai, Dr. Kiran Sangani, Consultant in Preventive Cardiology and Rehabilitation, Qi Lifecare, Mumbai, Mr. Kaushik Panchal, Founder and Owner at Runners Academy, Mumbai and Mrs. Suchita Varadkar, Trainer at Topgear MIG Bandra, Mumbai for their help in procuring subjects and Dr Wricha Mishra for valuable inputs in statistical analysis. Without their help this research would not have been possible.

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