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Myocardial Work Index: A Novel Method for Assessment of Myocardial Function in South Asian Recreational Athletes

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Purpose	We used a novel noninvasive method based on speckle-tracking echocardiography to evaluate myocardial performance in South Asian recreational athletes who completed a half marathon.
Methods	Transthoracic echocardiography was performed on 24 recreational athletes 48 hours before they took part in a half marathon (premarathon), within 2 hours of half marathon completion (postmarathon), and 72 hours after completion. Clinical, laboratory, and echocardiographic variables were collected. Speckle-tracking echocardiography was performed in all subjects to characterize myocardial mechanics.
Results	Mean age of participants was 41.8 ± 7.4 years, and 23 (95.8%) were male. No subject had a prior history of coronary artery disease. Significant changes in pre- and postmarathon values suggested myocardial injury, including an increase in mean brain natriuretic peptide (BNP), an increase in left atrial volume, and an overall reduction in peak left ventricular global longitudinal strain. All subjects had a similar value of global work index, the average myocardial work, premarathon. Global work index did not change in 11 patients (Group 1), and global work index increased in 13 patients (Group 2) immediately postmarathon. Group 2 patients were noted to have higher heart rate, lower end-diastolic and end-systolic volumes, and higher BNP levels, suggesting myocardial stress.
Conclusions	South Asian athletes completing a half marathon exhibited two different responses to the cardiac stress of the half marathon, as outlined by the use of myocardial work indices, a novel method for assessing cardiac performance. (<i>J Patient Cent Res Rev.</i> 2020;7:147-156.)
Keywords	echocardiography; myocardial function; athletes; marathon; endurance running; heart stressors

The effects of marathon running on cardiovascular performance in South Asian recreational athletes have never been studied in a dedicated fashion. Echocardiographic and clinical data from other populations are conflicting: long-term running is associated with an overall improvement in cardiovascular performance,¹⁻³ although, in the short-term, marathon

completion has been associated with subclinical cardiac injury in certain populations as assessed by transient elevation in cardiac biomarkers^{4,5} and abnormal echocardiographic variables.^{6,7} While there is great enthusiasm among middle-aged, amateur athletes worldwide in marathon training and event participation, there are conflicting reports in the literature about beneficial or deleterious effects on the cardiovascular system with prolonged endurance exercise training.⁸

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Left ventricular (LV) peak global longitudinal strain (GLS), derived from speckle-tracking transthoracic echocardiography (TTE), has been demonstrated to be

abnormal in amateur runners after marathon training^{9,10} and may identify subclinical cardiac dysfunction. However, speckle-tracking strain echocardiography is sensitive to afterload, leading to limitations in accuracy when afterload is not factored into the analysis.^{11,12} The global myocardial work index (GWI) recently emerged as an innovative noninvasive method for evaluating myocardial performance. The technique uses existing echocardiographic data for longitudinal strain analysis coupled with noninvasive blood pressure measurements to obtain a pressure-strain loop of cardiac performance.¹³ The advantage of GWI is that it takes into account afterload and, thus, results in a more accurate assessment of myocardial performance.

We evaluated serial clinical, echocardiographic, and GWI parameters in South Asian recreational athletes who completed a half marathon. We aimed to evaluate myocardial work performance in these subjects prospectively and correlate it with conventional echocardiographic and clinical variables. Such study may give insight into variable effects of endurance training, thereby potentially guiding individual athletic achievement goals and training intensity.

METHODS

Study Population

South Asian recreational athletes were recruited prospectively to participate in this study from a health care institution in Nagpur, India. Recreational athletes who were registered for a half marathon were eligible for inclusion. Exclusion criteria were hypertension, preexisting coronary artery disease, preexisting significant valve abnormalities, congestive heart failure, any arrhythmia, abnormal echocardiogram, and poor echocardiogram image quality that would prohibit use of speckle-tracking echocardiography.

Demographic data, including age, sex, height, weight, and prior half-marathon experience, were collected 48 hours prior to the half marathon. Laboratory, echocardiographic, and myocardial performance data were collected at 3 time points: 1) a premarathon visit 48 hours prior to a half marathon (Pre); 2) a postmarathon visit within 2 hours of completion of a half marathon (Post); and 3) a visit 72 hours after half marathon completion (Late).

Research was conducted using principles from the Declaration of Helsinki and was reviewed by the local ethics committee. Informed consent was obtained from all subjects.

Laboratory Data

All subjects underwent laboratory testing for serum N-terminal prohormone brain natriuretic peptide (NT pro-BNP) levels (pg/mL) drawn at the 3 time points (Pre, Post, Late). Serum creatinine (mg/dL) and cholesterol levels (total, high-density lipoprotein, very-low-density lipoprotein, low-density lipoprotein, and triglycerides [mg/dL]) were drawn at the Pre and Post time points.

Echocardiographic Data

All subjects underwent complete TTE imaging at the designated 3 time points. TTE was performed using a M5S 3.5-mHz transducer on the Vivid E9 ultrasound system (GE Vingmed Ultrasound AS, Horten, Norway). Standard TTE views were obtained, including assessment of LV dimensions, LV volumes, LV ejection fraction (calculated from Simpson's biplane method of disks), left atrial (LA) length in the parasternal long-axis view, LA area in the apical 4-chamber view, and LA volume calculated from the apical 4- and 2-chamber views. Mitral valve inflow was assessed using pulsed-wave interrogation at the mitral valve leaflets; pulsed-wave tissue Doppler imaging was performed to assess septal and lateral mitral annular velocities. Indices of right ventricular (RV) function (tricuspid annular plane systolic excursion and RV fractional area change) were assessed using standard focused RV apical views.

Speckle-tracking echocardiography was then used to calculate RV GLS: the RV endocardial border was traced, and peak RV GLS was calculated using the average free-wall RV segments as they shortened during systole.

All echocardiography studies were acquired by one physician with expertise in cardiac imaging, and all echocardiographic measurements were done by one master's-level cardiac technician with 4 years of clinical experience. All echocardiographic images were acquired and measured in standard format as outlined in the most recent American Society of Echocardiography guidelines.¹⁴

Myocardial Work Analysis

The GWI was calculated by another independent physician with cardiac imaging expertise. Speckle-tracking echocardiography was used to calculate LV GLS curves using optimized apical 2-, 3-, and 4-chamber views at a frame rate of 50–80 frames/second. Aortic valve closure timing was calculated using automatic function imaging from the apical 3-chamber view. The LV endocardial border was traced in each view at end-diastole. Peak LV GLS was then performed using echocardiography software that divided the myocardium into 6 segments in each view, creating graphs of shortening over the cardiac cycle. A bull's-eye plot was created of peak LV GLS for each myocardial segment.

Systemic blood pressure was measured noninvasively with subjects in a resting supine state just prior to the start of echocardiography; it was assumed to be reflective of peak arterial pressure. The system used this input for calculation of a bull's-eye plot of myocardial work, quantifying myocardial work across individual segments of the LV myocardium and calculating GWI as an average of all segments (Figure 1).

The software also generated a pressure-strain loop from speckle-tracking data (Figure 2), and other parameters were calculated. The area within the curve — total work from mitral valve closure to mitral valve opening — represented GWI. Global constructive work (GCW) was the work performed by the myocardium that was productive to LV ejection fraction, a combination of the shortening of the LV during systole and the lengthening of the LV during isovolumic relaxation. Global wasted work (GWW) represented the work that was unproductive to LV ejection fraction, a combination of lengthening during systole and shortening during isovolumic relaxation. The ratio of constructive work to total work (both constructive and wasted work) formed the myocardial work efficiency (GWE) (Figure 3).

Statistical Analysis

Continuous variables were reported as mean $\pm$ standard deviation. Comparison of variables among the 3 time points was performed and tested for significance using paired *t*-test. Two groups were identified from the raw data (Group 1: no significant change in GWI between pre- and postmarathon; Group 2: significant increase in GWI between pre- and postmarathon).

Figure 1. Creation of myocardial work bull's-eye plot. Peak global longitudinal strain is derived from 3 high-quality apical views of the myocardium (left panel, from top, apical 2-, apical 3-, and apical 4-chamber transthoracic echocardiographic views). The bull's-eye plot of peak systolic strain is sensitive to afterload. Using noninvasive systolic blood pressure as a surrogate for systemic left ventricular pressure, a second bull's-eye plot of myocardial work is created (right panel). Myocardial work based on blood pressure and global longitudinal strain is calculated from a complex algorithm within ultrasound machine software (GE Healthcare, Chicago, IL).

GLS: -19%
GWI: 2034 mmHg%
GCW: 2108 mmHg%
GWW: 31 mmHg%
GWE: 98%

Figure 2. Creation of myocardial work pressure-strain loops. Peak global longitudinal strain (GLS) and afterload (systolic blood pressure) are used to generate a pressure-strain loop, similar to a pressure-volume loop of the left ventricle. The area under the curve represents total myocardial work. AVC, aortic valve closure; AVO, aortic valve opening; GCW, global constructive work; GWE, global work efficiency; GWI, global work index; GWW, global wasted work; LVP, left ventricular pressure; MVC, mitral valve closure; MVO, mitral valve opening.

Comparison of variables between Group 1 and Group 2 patients was performed using 2-sample *t*-test to evaluate for group difference in continuous variables. A linear mixed model was fitted to assess association of BNP over time, adjusting for group (Group 1 vs Group 2). For the BNP analysis, a model with BNP as the outcome and “time” and “group” as independent predictors of BNP was fitted. All analysis was performed using SAS Version 9.4 (SAS Institute Inc., Cary, NC). Level of significance was evaluated at 5% ($P < 0.05$).

RESULTS

Of the 24 South Asian recreational athletes eligible to participate in this study, 23 (98%) were male and the mean age was 41.4 ± 7.7 years. There were 23 participants with prior marathon experience (19 had completed >1 half marathon, and 7 had completed >1 full marathon). Mean weight of the population was 72.9 ± 8.4 kg, and mean body mass index was 25.4 ± 2.7 kg/m².

Mean heart rate did not change significantly at the 3 time points: Pre 73.6 ± 7.2 bpm; Post 75.4 ± 8.5 bpm; and Late 74.5 ± 6.5 bpm ($P = 0.48$ for Pre vs Post; $P = 0.64$ for Pre vs Late). Systolic blood pressure did not change significantly at the time points; mean systolic blood pressure was 113.8 ± 5.8 mmHg at Pre, 115.8 ± 6.5 mmHg at Post, and 111.7 ± 3.8 mmHg at Late ($P = 0.30$ for Pre vs Post; $P = 0.09$ for Pre vs Late).

There were 18 participants (75%) who used professional guidance in training for the half marathon. The mean number of months of training was 8.8 ± 3.1 months, and the mean number of days per week was 4 ± 1.6 days.

Laboratory Variables

Mean cholesterol values of patients were normal at the Pre time point (total cholesterol: 164.5 ± 33.6 mg/dL; triglycerides: 136.2 ± 30.1 md/dL; high-density lipoprotein: 57.0 ± 8.4 mg/dL; low-density lipoprotein 82.2 ± 23.0 mg/dL) and did not change significantly when checked at the Post time point. Mean serum creatinine increased at the Post time point (0.9 ± 0.1 pg/mL to 1.1 ± 0.2 pg/mL; $P = 0.0002$). Mean NT pro-BNP increased significantly at the Post time point (33.2 ± 21.8 pg/mL to 53.3 ± 24.6 pg/mL; $P = 0.0072$) and remained elevated at the Late time point (41.0 ± 22.4 pg/mL; $P = 0.0035$).

Global Work Index (GWI) = The amount of myocardial work performed by the left ventricle during systole = area under the pressure-strain curve (mmHg%)

Global Wasted Work (GWW) = Negative work performed in systole (lengthening) + Positive work performed in isovolumic relaxation (shortening)

Global Constructive Work (GCW) = Positive work performed in systole (shortening) + Negative work performed in isovolumic relaxation (lengthening)

Myocardial Work Efficiency (GWE) = Percentage of constructive work over total work = $GCW / GCW + GWW$

Figure 3. Definitions of myocardial work indices. Global myocardial work index is derived from peak global longitudinal strain and afterload. Using the pressure-strain loops created, it is possible to ascertain global constructive work (GCW, work that contributes to left ventricular ejection fraction) and global wasted work (GWW, work that does not contribute to left ventricular ejection fraction).

Echocardiographic Variables

There were no significant changes in LV diastolic dimensions at the Pre and Post time points. LV end-systolic dimension increased at the Post time point (2.9 ± 0.5 cm Pre vs 3.2 ± 0.5 cm Post; $P=0.02$) and then reverted to similar size at the Late time point (3.0 ± 0.5 cm; $P=0.72$ for Pre vs Late). There was no change to LV end-diastolic volume from Pre to the other time points. LV ejection fraction was unchanged at the time points and remained normal in subjects

throughout the study. There were no significant changes in LV diastolic function parameters at any of the time points.

All indices of LA size increased at the Post time point and remained enlarged at the Late time point. LA area in the apical 4-chamber view increased from Pre (11.8 ± 3.3 cm²) to Late (15.8 ± 3.2 cm²; $P<0.0001$). LA length in the parasternal long-axis view measured at LA systole increased from 3.7 ± 0.6 cm to 4.6 ± 0.6 cm ($P<0.0001$). LA volume increased at the Post time point (30.8 ± 10.2 mL Pre to 49 ± 16.0 mL Post; $P<0.0001$) and remained elevated at the Late time point (43.2 ± 14.5 mL; $P<0.0001$ for Pre vs Late).

There was a trend toward reduction in peak LV GLS from the Pre time point ($-18.9\% \pm 2.0\%$) to the Post time point ($-17.7\% \pm 3.7\%$; $P=0.06$ for Pre vs Post), and a significant reduction in Late GLS values ($-16.8\% \pm 3.1\%$; $P=0.001$ for Pre vs Late).

There was a trend toward increased RV diastolic area, but it was not significant. There was no significant change in RV systolic area. Conventional measurements of RV longitudinal function (tricuspid annular plane systolic excursion and tricuspid valve S' velocity) also remained unchanged. Absolute RV GLS improved Post and Late ($-22.0\% \pm 4.3\%$ Pre vs $-25.2\% \pm 4.9\%$ Post vs $-26.8\% \pm 2.8\%$ Late ($P=0.017$ for Pre vs Post; $P=0.0046$ for Pre vs Late). RV fractional area change improved significantly from Pre to Late ($32.5\% \pm 12.2\%$ vs $43.9\% \pm 9.4\%$; $P=0.0017$).

Myocardial Performance Indices

Myocardial work performance indices for all 24 athletes are listed in Table 1. In this relatively healthy population with structurally normal hearts, the baseline GWI was 1851.9 ± 144.1 mmHg%. GWW was minimal (50.7 ± 8.5 mmHg%), and overall GWE was high ($94.8\% \pm 2.1\%$). When evaluating the individual myocardial work of each athlete, two trends emerged: Group 1 ($n=11$) encompassed individuals whose GWI did not change significantly postmarathon; and Group 2 ($n=13$) encompassed individuals whose GWI increased postmarathon (Figure 4). GWI in both Groups 1 and 2 returned to baseline at the Late time point (Table 2). There were no significant changes in GWW, GWE, or GCW between the two groups, demonstrating that

Table 1. Myocardial Performance Indices for 24 Athletes: Premarathon, Immediately Postmarathon, and 72 Hours Postmarathon

	Pre	Post (Immediate)	Late (72 Hours)	P (Pre vs Post)	P (Pre vs Late)
Global work index, mmHg%	1851.9 ± 144.1	1875.2 ± 155.1	1858.1 ± 96.8	0.52	0.86
Global constructive work, mmHg%	1831.5 ± 141.2	1854.5 ± 141.3	1834.9 ± 102.4	0.06	0.14
Global wasted work, mmHg%	50.7 ± 8.5	53.8 ± 11.3	49.6 ± 6.7	0.50	0.92
Global work efficiency, %	94.8 ± 2.1	95.8 ± 2.3	95.7 ± 1.6	0.35	0.63

Data are presented as mean ± standard deviation or P-value.

Figure 4. Myocardial global work index (GWI) (measured as mmHg%) trends in two groups. Group 1 exhibited no significant change in myocardial performance after completing a half marathon. Group 2 exhibited a significant augmentation in myocardial performance after completing a half marathon. Time 0 = premarathon; Time 1 = immediately after marathon; Time 2 = 72 hours postmarathon.

Group 2 had increased GWI in response to running the half marathon but maintained the same ratio of constructive work to total work.

We then re-examined clinical characteristics between the two groups (Table 3). Group 1 (no change in myocardial work at Post) had a lower heart rate immediately postmarathon (71.76 ± 7.29 bpm vs 76.79 ± 6.76 bpm; $P=0.0006$). Group 1 patients had larger end-diastolic volumes (98.42 ± 23.48 mL vs 79.33 ± 16.65 mL; $P=0.0154$) and larger end-systolic volumes

(45 ± 13.56 mL vs 32.54 ± 8.44 mL; $P=0.0032$). Group 1 patients also demonstrated lower mean serum NT pro-BNP at Post (36.7 ± 19.14 mcg/dL vs 47.44 ± 26.92 mcg/dL; $P=0.003$). There were no significant differences in LA dimensions, RV size and function variables, or diastolic function between the two groups. There were no significant differences in inferior vena cava dimensions, a surrogate for intravascular volume status, between groups. There were also no significant differences in intensity of training, marathon completion time, and prior marathon experience between groups. Specifically, there were no differences between Group 1 and Group 2 patients in use of professional guidance, number of months of training, and mean number of days per week of training.

DISCUSSION

In this study, we evaluated myocardial performance in South Asian recreational athletes after completion of a half marathon, evaluating both clinical and echocardiographic variables and novel myocardial work indices.

Myocardial stress has been demonstrated to occur acutely postmarathon in a variety of populations. When 69 nonelite marathon runners were evaluated in Boston, troponin and NT pro-BNP concentrations increased immediately postmarathon and RV dilation and dysfunction were noted to occur; diastolic dysfunction also worsened acutely postmarathon, with no change in LV ejection fraction.⁵ Similar findings were noted in amateur athletes completing the 2006 Berlin marathon.⁹ Roca et al demonstrated serum BNP elevations and LV GLS reductions acutely

Table 2. Responses in Global Myocardial Work Index

Variable	Group 1 (n=11)	Group 2 (n=13)	P
Premarathon			
GWI	1836.3 ± 119.0	1865.2 ± 166.0	0.6352
GWE	94.5 ± 2.0	95.1 ± 2.3	0.4913
GCW	1804.6 ± 97.6	1854.4 ± 170.4	0.4009
GWW	50.6 ± 8.3	50.8 ± 9.0	0.9503
Postmarathon			
GWI	1736.3 ± 45.7	1992.7 ± 108.3	<0.0001
GWE	95.4 ± 2.7	96.2 ± 1.9	0.3684
GCW	1811.4 ± 159.2	1890.9 ± 118.4	0.1746
GWW	50.1 ± 7.0	57.0 ± 13.5	0.1248
Late (72 hours post)			
GWI	1821.5 ± 85.9	1889.1 ± 97.7	0.0882
GWE	96.0 ± 1.9	95.5 ± 1.4	0.4317
GCW	1799.2 ± 114.3	1865.1 ± 84.0	0.1181
GWW	48.7 ± 7.6	50.4 ± 6.1	0.5606

Note: There were 2 responses noted in global myocardial work index postmarathon — a decrease or no change in myocardial work in Group 1 and an increase in Group 2.

GCW, global constructive work; GWE, global work efficiency; GWI, global work index; GWW, global wasted work.

postmarathon in 79 recreational athletes completing the Barcelona marathon, suggesting these were indicators of myocardial injury.¹⁵

Our findings are similar and extend this data further. We noted LA dilation immediately after half marathon completion and persisting 72 hours post-half marathon completion. We noted similar preservation of LV ejection fraction but subclinical LV dysfunction, which was identifiable by a reduction in LV GLS in the postmarathon time period. Our findings suggest left-sided myocardial stress from half-marathon running in South Asian recreational athletes. This persistent LA dilation may have other important implications, as it may explain some of the association with late-onset atrial fibrillation in endurance athletes.¹⁶⁻¹⁸

As opposed to LV function, we noted improvement in RV function immediately after a half marathon. RV longitudinal and radial function improved, as seen by an increase in RV GLS and RV fractional area change. These results are in contrast to other

Table 3. Characteristics of Group 1 (No Change in GWI) and Group 2 (Increased GWI Postmarathon) Patients (Time-Averaged)

Variable	Group 1 (No Change in GWI)	Group 2 (Increased GWI)	P
Systolic blood pressure, mmHg	114.85 ± 5.66	112.82 ± 5.6	0.1003
Diastolic blood pressure, mmHg	73.94 ± 4.96	73.59 ± 4.86	0.7719
Heart rate, bpm	71.76 ± 7.29	76.79 ± 6.76	0.0006
End-diastolic volume, mL	98.42 ± 23.48	79.33 ± 16.65	0.0154
End-systolic volume, mL	45 ± 13.56	32.54 ± 8.44	0.0032
LV ejection fraction, %	55.67 ± 6.12	57.72 ± 8.65	0.4116
Left atrial area, cm ²	14.02 ± 3.37	13.14 ± 4.32	0.3455
Left atrial length, cm	4.34 ± 0.62	3.97 ± 0.81	0.0614
RV fractional area change, %	0.41 ± 0.08	0.36 ± 0.14	0.0722
Septal e', m/sec	0.12 ± 0.02	0.12 ± 0.02	0.5794
Lateral e', m/sec	0.13 ± 0.02	0.13 ± 0.03	0.7815
TAPSE, cm	2.15 ± 0.31	2.21 ± 0.29	0.1240
LVOT velocity time integral, cm	21.44 ± 4.43	21.55 ± 3.21	0.7892
Absolute LV GLS, %	16.96 ± 2.84	18.44 ± 3.22	0.5614
Absolute RV GLS, %	24.67 ± 3.81	24.64 ± 5.05	0.8240
BNP, mcg/dL	36.7 ± 19.14	47.44 ± 26.92	0.0300

Data are presented as mean ± standard deviation or P-value.

BNP, brain natriuretic peptide; GLS, global longitudinal strain; GWI, global myocardial work index; LV, left ventricular; LVOT, left ventricular outflow tract; RV, right ventricular; TAPSE, tricuspid annular plane systolic excursion.

studies that demonstrated occult RV dysfunction in marathon runners and ultra-endurance athletes.¹⁹⁻²¹ It is possible that we did not see acute RV dysfunction in our population due to the shorter distance of a half marathon versus a full marathon. We would hypothesize that the RV may initially accommodate increased preload and transiently increase RV radial and longitudinal function in response to exercise at shorter distances; at longer distances, RV fatigue may develop. Our observation will require further exploration and suggests a threshold of RV adaptability to exercise, beyond which RV dysfunction can occur.

We evaluated myocardial work, an echocardiographic index of global myocardial function. Myocardial work indices, as calculated from noninvasive methods using speckle-tracking echocardiography, have been demonstrated to correlate excellently with traditional pressure-volume loops. This noninvasive method was further investigated in human models and noted to be a surrogate for overall myocardial consumption.¹³ Myocardial work indices have been explored in areas where regional differences in LV function can be clinically significant, such as cardiac dyssynchrony,²² and in response to hypertension and loading conditions in cardiomyopathies.²³ A recent report also shed light on normative values and lower limits of normal thresholds using data from 226 healthy Caucasians.²⁴

We explored myocardial work in South Asian subjects pre- and post-half marathon completion. In this relatively healthy population with no known coronary artery disease, GWI was normal before and after the half marathon, GWW was minimal, and GWE was high. The addition of myocardial performance indices allowed us to identify two categories of response to half marathon completion that we would not have been able to identify from conventional echocardiographic variables: Group 1 was noted to complete the half marathon without a significant change in GWI, and Group 2 completed the half marathon by increasing their GWI. There were no significant changes in GWW between the groups. Group 2 patients (with increased GWI) were different from Group 1 in 3 key areas postmarathon: 1) higher heart rate, 2) higher BNP values, and 3) lower myocardial volumes. This suggests that the mechanism of increased myocardial work in Group 2 patients was not driven by an increase in preload and

stroke volume, but rather by an increase in heart rate. Group 1 patients completed the half marathon with overall less myocardial consumption (surrogate for myocardial work) and at a lower postexercise resting heart rate. The modest increase we observed in serum BNP level postmarathon has been well-established²⁵ and can be considered a marker of myocardial stress.

Together, these findings suggest that, although there were no significant differences in time to completion of a half marathon, Group 2 patients exhibited higher myocardial consumption to complete it. This may represent an early manifestation of myocardial stress, an initial increase in myocardial consumption with increased heart rate, which may be a precursor to myocardial fatigue. Both groups had returned to normal at the Late time point, suggesting that this effect is transient. The long-term implication of this finding will need to be explored further in larger multicenter studies.

Limitations

This is a single-center exploratory study. The cohort studied completed the half marathon, and there was no control group available for comparison. Nonetheless, baseline levels of myocardial work in our population were similar to recently published values of normal.²⁴ As this is a prospective study, our study gives robust information about a new index of myocardial performance. The cohort studied was followed-up at 3 time points and provides us new insights about understanding the cardiac effects of marathon completion. Further studies can be done to prospectively look at the impact of premarathon training on these indices in a larger population. Finally, in this small, hypothesis-generating study, only 1 participant was female, therefore, our findings cannot be extrapolated to women; we look forward to evaluating sex differences in myocardial work in recreational athletes in future studies.

CONCLUSIONS

We evaluated myocardial performance in South Asian athletes completing a half marathon using a novel method of assessing myocardial performance, the myocardial work index. This new method helps to provide more insights into understanding the cardiac effects of marathon completion. Further multicenter studies are warranted to evaluate the impact of marathon completion on overall myocardial work.

Patient-Friendly Recap

- Running a marathon has been associated with short-term heart dysfunction in certain populations.
- The authors of this study found that South Asian athletes completing a half marathon exhibited two different responses to the resulting cardiac stress.
- Significant changes to “myocardial work index” values after the race indicated heart function had been negatively impacted. Levels did return to normal after 72 hours, suggesting that this effect is temporary.
- Myocardial work index is a novel method to assess cardiac performance using echo imaging and should be studied further.

Author Contributions

Study design: Sengupta, Jain, Burkule, Khandheria. Data acquisition or analysis: Sengupta, Jain, Burkule, Olet. Manuscript drafting: Sengupta, Jain. Critical revision: Sengupta, Jain, Burkule, Khandheria.

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Conflicts of Interest

None.

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