

## Yoga-Based Postoperative Cardiac Rehabilitation Program for Improving Quality of Life and Stress Levels: Fifth-Year Follow-up through a Randomized Controlled Trial

### Abstract

**Objectives:** This study was aimed to assess the efficacy of yoga-based lifestyle program (YLSP) in improving quality of life (QOL) and stress levels in patients after 5 years of coronary artery bypass graft (CABG). **Methodology:** Three hundred patients posted for elective CABG in Narayana Hrudayalaya Super Speciality Hospital, Bengaluru, were randomized into two groups: YLSP and conventional lifestyle program (CLSP), and follow-up was done for 5 years. **Intervention:** In YLSP group, all practices of integrative approach of yoga therapy such as *yama*, *niyama*, *asana*, *pranayama*, and meditation were used as an add-on to conventional cardiac rehabilitation. The control group (CLSP) continued conventional cardiac rehabilitation only. **Outcome Measures:** World Health Organization (WHO)-QOL BREF Questionnaire, Perceived Stress Scale, Positive and Negative Affect Scale (PANAS), and Hospital Anxiety and Depression Scale (HADS) were assessed before surgery and at the end of the 5<sup>th</sup> year after CABG. As data were not normally distributed, Mann-Whitney U-test was used for between-group comparisons and Wilcoxon's signed-rank test was used for within-group comparisons. **Results:** At the end of 5 years, mental health ( $P = 0.05$ ), perceived stress ( $P = 0.01$ ), and negative affect (NA) ( $P = 0.05$ ) have shown significant improvements. WHO-QOL BREF score has shown improvements in physical health ( $P = 0.046$ ), environmental health ( $P = 0.04$ ), perceived stress ( $P = 0.001$ ), and NA ( $P = 0.02$ ) in YLSP than CLSP. Positive affect has significantly improved in CLSP than YLSP. Other domains of WHO-QOL-BREF, PANAS, and HADS did not reveal any significant between-group differences. **Conclusion:** Addition of long-term YLSP to conventional cardiac rehabilitation brings better improvements in QOL and reduction in stress levels at the end of 5 years after CABG.

**Keywords:** Cardiac rehabilitation, coronary artery bypass graft, coronary heart disease, meditation, yoga-based lifestyle program

### Introduction

Quality of life (QOL) and stress levels after coronary artery bypass graft (CABG) surgery are important assessments to improvise health strategies in the management of coronary artery disease (CAD).<sup>[1]</sup> There could be definitive complications of surgery such as the risk of failure,<sup>[2,3]</sup> resulting in higher mortality rate at 5 years than 1 year after CABG,<sup>[4]</sup> with 6.3% requirement of revascularization.<sup>[5]</sup> QOL scores correlate with survival rates and both are affected adversely by the stress levels. The QOL improves at 5 years without any association with preoperative ejection fraction (EF),<sup>[6]</sup> but this association was not found at 12 years of CABG.<sup>[7,8]</sup>

Lifestyle behavior follow-up is poor in low-income countries,<sup>[9]</sup> especially in

young CABG patients,<sup>[10]</sup> and after the first diagnosis of CAD, hence, it is important to develop a simple, effective, and low-cost strategies for the secondary prevention of further morbidity and mortality.<sup>[9]</sup>

Worldwide, approximately 20% of people who receive primary health care have depression or anxiety disorders in general.<sup>[11]</sup> Anxiety is associated with high risk of coronary heart disease (CHD) mortality in particular of prior depression status.<sup>[12]</sup> The presence of anxiety and/or depression before surgery has the effect on cardiac rehabilitation outcomes after surgery, and both the factors are triggered and contributed using stress levels; hence, there is a need for early diagnosis and supportive therapeutics that involve mind-body interventions.<sup>[13]</sup> There is need for

**Eraballi Amaravathi,  
Nagendra  
Hongasandra  
Ramarao,  
Nagarathna  
Raghuram,  
Balaram Pradhan**

*Division of Yoga and Life  
Sciences, Swami Vivekananda  
Yoga Anusandhana Samsthana  
University, Bengaluru,  
Karnataka, India*

**Address for correspondence:**  
Dr. Eraballi Amaravathi,  
Division of Yoga and Life  
Sciences, Swami Vivekananda  
Yoga Anusandhana Samsthana  
University, 19 Eknath Bhavan,  
Gavipuram Circle, Kempegowda  
Nagar, Bengaluru, Karnataka,  
India.  
E-mail: om.amaravathi@gmail.  
com

#### Access this article online

**Website:** www.ijoy.org.in

**DOI:** 10.4103/ijoy.IJOY\_57\_16

#### Quick Response Code:



**How to cite this article:** Amaravathi E, Ramarao NH, Raghuram N, Pradhan B. Yoga-based postoperative cardiac rehabilitation program for improving quality of life and stress levels: Fifth-year follow-up through a randomized controlled trial. *Int J Yoga* 2018;11:44-52.

**Received:** September, 2016. **Accepted:** March, 2017.

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

interventions which target stress management<sup>[14]</sup> and improve QOL, in particular after CABG.<sup>[8]</sup>

Cognitive behavioral therapies and other mindfulness-based stress management programs can bring significant change in depression scores than usual care after CABG<sup>[15]</sup> and also improve the physical and mental health.<sup>[16,17]</sup> However, these programs require one-to-one sessions with a specialist and are time-consuming and costly. Yoga therapy is simple and cost-effective, it can be offered in groups, and people can be trained to practice regularly on their own with regular monitoring and follow-ups. Studies on yoga after CAD<sup>[18]</sup> and CABG<sup>[11,15]</sup> are available. Long-term follow-ups of relaxation-based lifestyle change studies in CAD with or without myocardial infarction (MI) have been reported.<sup>[17,19,20]</sup>

In a previous randomized controlled study, we have reported the beneficial effects of yoga-based lifestyle program (YLSP) program as an add-on to conventional cardiac rehabilitation in improving left ventricular EF, psychological states, and various other risk factors at the end of 1<sup>st</sup> the year as compared to ELSP through randomized controlled trial (RCT).<sup>[21]</sup> The present study aims at looking at the effect of YLSP in QOL and stress levels after 5 years of CABG surgery.

## Methodology

The results of a year-long follow-up of the EF and other measures have been reported in our earlier publication.<sup>[21]</sup> At that time (2005–2007), all patients were advised to continue their home practices that were taught to them in person before discharge after CABG in the hospital.

## Subjects

In the initial funded (Ministry of Health and Family Welfare, Central Ministry, New Delhi, India) project on the effect of YLSP, conducted between 2005 and 2007 at Narayana Hrudayalaya Institute of Cardiac Sciences (NHICSc), Bengaluru, we had recruited 300 participants who satisfied the selection criteria from a pool of 1026 screened patients who were posted for CABG (trial profile).

## Selection criteria

The inclusion criteria for the study were (a) males posted for CABG with double or triple vessel disease, (b) EF above 30%, and (c) those residing within 200 km distance from the hospital. Those with other system diseases, those with EF <30%, those who were posted for valve repair in addition to CABG, and emergency CABG cases were excluded from the study [Table 1]. For the present study, we included all those cases who could give us the feedback; in the case of death, we had obtained the information from the relatives who received the follow-up phone calls or letter.

## Ethical clearance and informed consent

The present follow-up study protocol was approved by the Ethical Committee of NHICSc and Swami Vivekananda Yoga Anusandhana Samasthana (SVYASA) University.

Written informed consent was obtained at the time of recruitment for the RCT which had mentioned about the long-term follow-up.

## Procedure

The present study reports the results of the 5<sup>th</sup>-year follow-up of those who were recruited for the initial RCT between 2005 and 2007. For this follow-up study, the research team was in continuous contact with all the participants through phone calls and reminder letters. One of the research team members met the participant at these follow-up visits. All those who came for the follow-up went through a review session of yoga (experimental group) or exercise (control group) practice session for 1 h and gave their feedback on the current health status and completed the psychological questionnaires. The results of the follow-up investigations were reviewed by the cardiology team with suitable advice on changes in medication and lifestyle.

## Measurements

- Perceived Stress Scale (PSS): It a self-reporting validated tool<sup>[19,22]</sup> for assessing the perception of stress over the past 1 month,<sup>[20,23]</sup> with the reliability of 0.85, and this can be used after CABG<sup>[21]</sup>
- Positive and negative affect scale (PANAS): PANAS has four subscales, i.e., positive affect (PA), negative affect (NA), other positive, and other negative consisting of 10, 10, 4, and 6 items each with validity and reliability of 0.86–0.9 for PA and 0.84–0.87 for NA<sup>[22,24]</sup>
- Hospital Anxiety and Depression Scale (HADS): A self-reported valid<sup>[23,25]</sup> instrument designed to assess the anxiety and depression in nonpsychiatric population. This questionnaire consists of two subscales of seven items for anxiety and depression. The report will be based on the past 2 weeks on the scale of four ranging from 0 (“not at all”) to 3 (“very much”). The reliability was 0.85 for HADS and 0.79 and 0.87 for the two subscales (HADS-anxiety [HADS-A] and HADS-depression [HADS-D])<sup>[24,26]</sup>
- QOL: World Health Organization (WHO) QOL-BREF has 26 questions developed by WHO. It is a scale that measures four domains such as physical (7 items), mental (6 items), social (3 items), and environmental health (8 items), which is perceived by the person. First and second questions related to “overall QOL” and “general health” facets are not included for scoring as per the user manual. The range of scores is 4–20 for each domain and scales in a positive direction (i.e., higher scores denotes higher QOL). The internal consistency is ranged from 0.66 to 0.87 (Cronbach’s alpha coefficient). This has good validity and test–retest reliability and is recommended for the use in health surveys and to assess the efficacy of any intervention at suitable intervals according to the study.<sup>[25,27]</sup>

## Intervention

### Practices common to both groups

The present study interventions include different practices; pharmacotherapy, study material, and the cardiac rehabilitation program for 30 min by a physiotherapy expert were common to both the groups.

### Experimental group (yoga-based lifestyle program)

Yoga starting with simple and safe practices suited to the stamina of participant is used. Integrative approach of yoga therapy-based yoga modules which are described in detail in our previous work<sup>[21]</sup> was used [Table 2]. Counseling on lifestyle modification includes concepts of *Ashtanga yoga (Yama, Niyama)* with the scientific background.

### Control group (physiotherapy-based lifestyle program: Conventional lifestyle program)

Warm-up exercises including breathing exercises and some more physiotherapy-based exercises in different positions as per the stamina and those comparable with *yoga asanas* were administered [Table 2]. Counseling was given by the physician about the lifestyle modification.

### Data analysis

SPSS version-20, Armonk NY: IBM Corp was used to analyze the data. Since the data were not normally distributed on Kolmogorov–Smirnov test, thus, nonparametric tests such as Wilcoxon’s signed-rank test and Mann–Whitney U-test (MWT) were used to compare the means within and between groups, respectively.

## Results

### Trial profile

The trial profile [Figure 1] represents the procedure of study from recruitment to 5<sup>th</sup> year after CABG. Three hundred individuals (150 in each group) who satisfied the selection criteria were recruited. Because of memories of trauma from CABG, mortality (two in conventional lifestyle program [CLSP], one in YLSP), long distance to travel to reach the hospital, and heavy traffic, we lost the follow-up of nearly 100 people in each group. Later, the imputation method was conducted to add the two missing items of each questionnaire. This happened both at baseline and 5<sup>th</sup>-year data. More than two items were excluded totally from other questionnaires also. This gave the less sample size for further analysis. Total of 36 in control group and 37 in yoga group is the sample size in all questionnaires and at both times of data collection.

Table 1 shows the demographic details. There was no significant difference of sample size between the groups, age, gender, education, or socioeconomic status. All of them were married, were graduates/postgraduates, and were in middle/low socioeconomic status. Most of them had hypertension, diabetes, and/or obesity. There was no difference between the groups for other risk factors as well.

**Table 1: Demographic data**

Categories	Groups		Chi-square test (P)
	CLSP	YLSP	
Sample size	150	150	-
Gender	Male	Male	-
Age range (years)	35-65	35-65	-
Educational level (%)			
School	25 (47.2)	28 (52.8)	2.04 (0.56)
Under graduation	47 (53.4)	41 (46.6)	
Graduation	36 (44.4)	45 (55.6)	
Postgraduation	42 (53.8)	36 (46.2)	
Religion (%)			
Hindu	138 (49.3)	142 (50.7)	0.85 (0.355)
Others	12 (60)	8 (40)	
Economic status (%)			
Upper class	12 (44.4)	15 (55.6)	0.51 (0.77)
Middle class	91 (51.4)	86 (48.6)	
Lower class	47 (49)	49 (51)	
Angiogram report (%)			
Single vessel disease	26 (61.9)	16 (38.1)	13.99 (0.003)
Double vessel disease	27 (37.5)	45 (62.5)	
Triple vessel disease	95 (51.9)	88 (48.1)	
Myocardial infarction	50 (66.7)	25 (33.3)	
Associated problems (%)			
Diabetes mellitus	74 (47.1)	83 (52.9)	2.12 (0.54)
Hyper tension	91 (51.7)	85 (48.3)	
Obesity	41 (42.7)	55 (57.3)	
Others	5 (45.5)	6 (54.5)	
Risk factors (%)			
Alcohol	18 (42.9)	24 (57.1)	1.19 (0.75)
Family history	26 (43.3)	34 (56.7)	
Smoking	19 (42.2)	26 (57.8)	
Tobacco	21 (52.5)	19 (47.5)	
Duration of coronary artery disease (year) (%)			
<1	83 (47.4)	92 (52.6)	0.55 (0.75)
1-5	59 (50.4)	58 (49.6)	
5-10	8 (42.1)	11 (57.9)	

CLSP = Conventional lifestyle program, YLSP = Yoga-based lifestyle program

### World Health Organization quality of life-BREF

Table 3 shows the results of QOL and perceived stress levels at 5<sup>th</sup> year of CABG participants.

### Total scores

Total WHO-QOL-BREF scores were nonsignificant change between groups after 5 years ( $P = 0.105$ ). There were significant improvement within YLSP group (4.36%,  $P = 0.097$ ) and nonsignificant change in CLSP group (-1.11%,  $P = 0.819$ ) after 5 years.

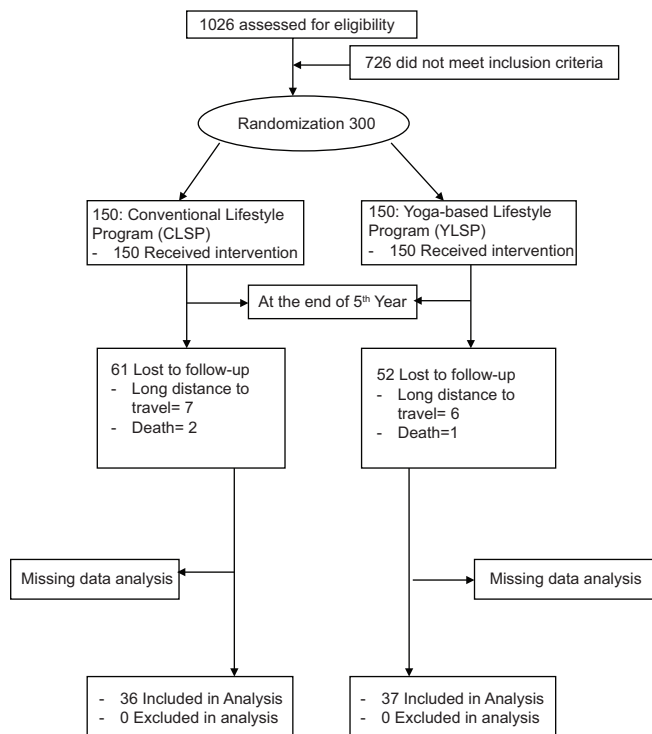
### Domain 1 (D1): Physical health

Physical health scores showed nonsignificant change between groups after 5 years ( $P = 0.167$ ). There were significant improvement within YLSP group (7.27%,

**Table 2: Intervention**

Duration	Conventional session details	Yoga session details
Baseline	Breathing practices Physiotherapy exercises for; wrist, back of hand, elbows, neck, back and legs	DRT MSRT <i>Nadi Shodhana Pranayama</i> - alternate nostril yoga breathing
Until 5 <sup>th</sup> year	Additional physiotherapy exercises in standing position Sit-ups, hip rotation, knee rotation, forward drill, backward drill, sideward drill, full arm rotation, free walking Sitting in a chair Ankle bending and toe bending Leg spread exercises with support-side ways, front and back Supine rest	Yogic breathing practices <i>Prasarita Hasta Swasah</i> - hands in and out breathing <i>Utkasita Hasta Swasah</i> - hands stretch breathing <i>Vyaghra Swasah</i> - tiger breathing <i>Ekapada Uttanasana Swasah</i> - straight leg raise breathing Standing <i>asanas</i> - 20 min <i>Ardha Kati Chakrasana</i> - lateral half wheel posture <i>Trikonasana</i> - triangle posture <i>Vrikshasana</i> - tree posture <i>Garudasana</i> - eagle posture Prone lying <i>asanas</i> <i>Bhujangasana</i> - serpent posture Sitting <i>asanas</i> <i>Vakrasana</i> - spinal twist with leg straight posture <i>Ardha Matsyendrasana</i> - half spinal twist posture <i>Vajrasana</i> - diamond posture Supine lying: QRT, DRT, and MSRT

DRT = Deep relaxation technique, MSRT = Mind sound resonance techniques, QRT = Quick relaxation technique



**Figure 1: Trial profile**

$P = 0.046$ ) and nonsignificant change in CLSP group (0.25%,  $P = 0.628$ ) after 5 years.

**Domain 2 (D2): Psychological**

Mental health scores showed significant improvement between groups after 5 years ( $P = 0.058$ ) with YLSP group showing better results than CLSP group. There was nonsignificant change in YLSP group (3.20%,  $P = 0.203$ ) and in CLSP group (-2.09%,  $P = 0.640$ ) after 5 years.

**Domain 3 (D3): Social relationships**

There was a nonsignificant improvement between the groups for the social interaction scores after 5 years ( $P = 0.141$ ). There were nonsignificant improvement in YLSP group (-2.12%,  $P = 0.601$ ) and significant improvement in CLSP group (-7.4%,  $P = 0.098$ ) after 5 years.

**Domain 4 (D4): Environment**

Environmental health scores showed the nonsignificant change between groups after 5 years ( $P = 0.240$ ). There were significant improvement within YLSP group (5.07%,  $P = 0.044$ ) and nonsignificant change in CLSP group (0.73%,  $P = 0.907$ ) after 5 years.

**Perceived stress scale**

Perceived stress scores were significantly reduced in the YLSP group as compared to CLSP group at the end of 5 years ( $P = 0.011$ ). There was significant improvement



**Table 3: Comparison of quality of life and perceived stress scale variables from baseline to 5<sup>th</sup> year**

Sub-scale	Group	n	Mean±SD		WSRT	Percentage change
			Baseline	5 <sup>th</sup> year		
D1	C	36	23.50±3.0	23.56±3.2	0.628	0.25
	Y	37	23.08±3.9	24.89±3.7	0.046*	7.27
	MWT		0.690	0.167		
D2	C	36	19.61±2.9	19.22±2.9	0.640	-2.09
	Y	37	20.22±3.4	20.89±3.4	0.203	3.20
	MWT		0.375	0.058*		
D3	C	36	10.44±1.7	9.72±2.1	0.098	-7.4
	Y	37	10.57±2.1	10.35±1.9	0.601	-2.12
	MWT		0.927	0.141		
D4	C	36	25.50±4.4	25.69±4.2	0.907	0.73
	Y	37	25.81±4.3	27.19±3.3	0.044*	5.07
	MWT		0.971	0.240		
Total	C	36	79.06±9.6	78.19±10.6	0.819	-1.11
	Y	37	79.68±12.1	83.32±10.8	0.097	4.36
	MWT		0.786	0.105		
PSS	C	36	16.72±5.3	19.03±4.4	0.063	12.13
	Y	37	19.57±5.0	16.59±3.9	0.001**	-17.96
	MWT		0.307	0.011*		

\* $P \leq 0.05$ , \*\* $P \leq 0.005$ . D1 = Physical health, D2 = Psychological, D3 = Social Relationships, D4 = Environment, PSS = Perceived stress scale, n = Sample size, C = Conventional lifestyle program, Y = Yoga-based lifestyle program, SD = Standard deviation, MWT = Mann-Whitney U-test, WSRT = Wilcoxon’s signed-ranks test

**Table 4: Comparison of positive and negative affect scale and hospital anxiety and depression scale variables from baseline to 5<sup>th</sup> year**

Subscale	Group	n	Mean±SD		WSRT	Percentage change
			Baseline	5 <sup>th</sup> year		
PANAS-PA	C	36	15.58±6.3	17.67±5.2	0.022*	11.82
	Y	37	17.84±5.9	18.97±5.8	0.364	5.95
	MWT		0.189	0.323		
PANAS-NA	C	36	7.47±4.3	10.78±4.8	0.003*	30.70
	Y	37	9.11±5.6	8.49±5.5	0.204	-7.30
	MWT		0.179	0.05*		
HADS-A	C	36	18.28±2.9	18.17±2.5	0.825	-0.60
	Y	37	18.08±2.5	18.16±2.9	0.940	0.44
	MWT		0.713	0.802		
HADS-D	C	36	15.39±3.5	15.67±2.5	0.621	1.78
	Y	37	15.68±2.5	15.35±2.4	0.545	-2.14
	MWT		0.542	0.573		

\* $P \leq 0.05$ , PANAS = Positive and negative affect scale, PA = Positive affect, NA = Negative affect, HADS = Hospital Anxiety and Depression Scale, A = Anxiety, D = Depression, n = Sample size, C = Conventional lifestyle program, Y = Yoga-based lifestyle program, SD = Standard deviation, MWT = Mann-Whitney U-test, WSRT = Wilcoxon’s signed-ranks test

within YLSP group (17.96%,  $P = 0.001$ ) with nonsignificant change in CLSP group (12.13%,  $P = 0.063$ ).

Table 4 shows the alternate assessment of stress like PANAS and HADS.

**Positive and negative affect scale**

PA scores did not show significant difference between the groups after 5 years ( $P = 0.323$ ). There were nonsignificant increase in PA in the YLSP group (5.95%,  $P = 0.364$ ) and significant improvement in the CLSP group (11.82%,  $P = 0.02$ ) after 5 years.

NA scores reveal significant improvement in the between-group differences after 5 years ( $P = 0.05$ ). There were nonsignificant reduction of NA scores in YLSP group (-7.3%,  $P = 0.204$ ) and significant increase within CLSP group (30.7%,  $P = 0.003$ ) after 5 years.

**Hospital anxiety and depression scale**

No significant between-group differences were observed for either HADS-A or HADS-D score at the end of 5 years. Although the results were not significant in within-group comparisons, there was higher tendency for YLSP group to show the reduction in depression scores (-2.14% in YLSP group vs. 1.78% in CLSP group).

**Discussion**

We observe that continuous practice of YLSP program as an add-on to conventional cardiac rehabilitation program leads to better improvement in the QOL and reduction of perceived stress as compared to physiotherapy-based lifestyle program in patients, 5 years after CABG. There was no significant difference between groups at the baseline.

To the best of our knowledge, there are no studies reporting 5-year follow-up on QOL after CABG. Studies show that surgical impacts are better for physical health and functional capacity of QOL after CABG, but the psychological domain of QOL remains unaffected.<sup>[26,28]</sup>

**Perceived stress scale**

The present study showed significant improvement in PSS scores after 5 years in YLSP group. Lifestyle counseling can reduce the over weight, lipid levels, blood pressure and glucose imbalances in cardiac risk population.<sup>[29]</sup> It has been observed that lateralization of cerebral activity during stress may stimulate the heart asymmetrically, and this may lead to cardiac arrhythmias.<sup>[30,31]</sup> Previously, mindfulness-based practice was used in experienced meditators wherein better cortisol recovery was observed after social stress test. Recovery of stress after mindfulness meditation has been demonstrated to be due to regulation of histone deacetylases and associated inflammatory pathways. This reflects the probable therapeutic mechanism of action of mind-body therapies such as yoga, in stress-related disorders.<sup>[27,29]</sup> Previously, it was observed that intensive lifestyle counseling helped patients with cardiovascular risk factors, by reducing their body weight, blood pressure, lipid, and glucose levels.<sup>[21,28,30]</sup> In another study, aerobic exercises for 35 min and 35 min of walking were compared with

stress management training for 16 weeks. It was observed that with its emphasis on emotion and behavior of person, stress management program lead to greater reduction in the general distress.<sup>[30,32]</sup> Worse physical health in terms of depression, osteoporosis, arthritis, cancer, prephysical problems, and poor mental health in terms of anxiety,<sup>[33]</sup> depression, and worse emotional score is more in elder patients after aortic valve replacement (AVR) with or without CABG.<sup>[34,35]</sup> The basic knowledge about the disease process and the steps to be taken after diagnosis also makes much difference in adherence to lifestyle program.<sup>[35,36]</sup> This may be the reason for nonsignificant improvements of the control group.

#### **Positive and negative affect scale - Positive affect**

It showed better nonsignificant improvement in CLSP group [Table 4]. This result is supported by a study showing association of self-care and PA scores after 1 year in chronic heart failure patients.<sup>[36,37]</sup> Circadian hyper amplitude tension and abnormal low diastolic BP have been associated with NAs.<sup>[38]</sup> PA scores correlated negatively with the tumor necrosis factors and interleukins in 79% men of  $67 \pm 9$  years of age.<sup>[38,39]</sup>

#### **Positive and negative affect scale - Negative affect**

It showed significant increase in CLSP compared to YLSP [Table 4]. In contrast, previously, another study observed similar results at 9<sup>th</sup> year of follow-up of CHD patients after conventional rehabilitation which may be the reason for less QOL in CLSP.<sup>[1,18,40]</sup> Non-significant increase of PANAS-PA in YLSP supported by the reduction of PANAS-NA might increase the QOL after CABG.<sup>[39]</sup> CLSP group showed increased negative emotions may be because of the trigger of acute coronary syndrome with negative emotions such as events in workplace.<sup>[40]</sup> In a population-based study, cardiovascular disease did not affect the emotional well-being of the subjects but shown association of negative emotions with cardiogenic drugs at old age of about 84 years.<sup>[41]</sup> May the risk aversion<sup>[42]</sup> from surgery, future life expectations<sup>[43]</sup> at the time of assessment show the personality change over a period of 5 years after CABG. Anxiety and depression are common for CABG before and after the surgery.<sup>[44]</sup> Better QOL after CABG reduce the chance of depression.<sup>[45]</sup> Anxiety has much influence on cardiac adverse events than distress after 5 years of CABG.<sup>[2]</sup>

#### **Hospital anxiety and depression scale**

Nonsignificant changes of HADS-A and HADS-D scores happened after 5 years in both groups [Table 4]. Depression reduced with lifestyle program after 1 year in CHD patients with or without diabetes mellitus.<sup>[45]</sup> Depression but not anxiety is associated with the number of hospitalizations, hospital stay, and all-cause mortality in ischemic heart disease.<sup>[46]</sup> In CHD, the chance of HADS-D score is more

and it will be much with the presence of risk factors like systolic blood pressure and body mass index.<sup>[47]</sup> High cholinergic neurotransmission associated with anxiety-like traits.<sup>[48]</sup> Anxiety may be associated with irregular growth hormone and melatonin rhythms which can be altered by basic lifestyle habits.<sup>[49]</sup> Minor events of daily life associates with adrenocortical activity.<sup>[50]</sup> Baseline psychological deviations between groups are because of the surgical trauma, and it can influence the outcomes of phase-2 rehabilitation.<sup>[12,13,51]</sup> One-quarter of cardiac arrest patients suffer from cognitive impairment that is dysfunction of medial temporal lobe and impaired short-term memory after 4 years of cardiac arrest.<sup>[52]</sup> Minor events of daily life associates with adrenocortical activity.<sup>[50]</sup>

#### **BREF-quality of life**

##### *Domain 1: Physical health (D1)*

There is significant improvement of physical health part of QOL in YLSP as in a study of add-on yoga in aerobic training.<sup>[3]</sup> The exercise capacity improved with home-based rehabilitation as in center based rehabilitation after MI<sup>[53]</sup> as the improvements of the CLSP group of the present study. Cardiac resynchronization therapy improves physical health after 4 years of CABG or AVR.<sup>[3]</sup>

##### *Domain 2: Psychological (D2)*

The present study showed nonsignificant improvement of mental health in YLSP as the supportive atmosphere, caring relationship, diet, and lifestyle change led to physiological changes such as reduction of anxiety, depression, and arrhythmia as in atrial fibrillation patients.<sup>[54]</sup> Both the functional capacity and the overall well-being improved paralelly after 2 years of heart transplantation with the possibility of comparing themselves with healthy individual than patients.<sup>[55]</sup>

##### *Domain 3: Social relationships (D3)*

Non-significant improvement in CLSP resembles the conventional rehabilitation program which reduced the resting heart rate and increases duration of exercises and peak oxygen consumption and overall QOL after CABG.<sup>[56,57]</sup> Conventional rehabilitation phase-3 along with relaxation technique has shown better QOL than individual techniques in cardiac syndrome.<sup>[58]</sup> Generalization of treatment after longterm follow up will improves the social functioning.<sup>[59]</sup>

##### *Domain 4: Environment (D4)*

Significant improvement in YLSP after 5 years has similarities with previous study where improvements are because of better coping ability if they are married, living with family and the children were employed<sup>[60]</sup> Previous regular leisure time activities prevent the suffering after CABG.<sup>[61]</sup> Therapeutic life style may need to be a central focus of mental, medical, and public health.<sup>[62]</sup>

## Total scores

Non-significant improvement of total QOL was observed in YLSP after 5 years. Low-intensity exercises can improve heart rate and functional capacity of CABG patients who has low- and moderate-risk factors.<sup>[63]</sup> Aerobic training and yoga improve the muscle strength, 6-min walk test distance,<sup>[64]</sup> which could be the base for overall improvement of health-related QOL.<sup>[60]</sup>

## Psycho-biological mechanisms

The present study showed that perceived stress, PA, NA, anxiety, and depression in day-to-day life are the initial step of physiological disturbance of the body. There is significant correlation found between general knowledge about the CHD risk factors and ability to follow lifestyle changes and medication.<sup>[65]</sup> Lateralization of cerebral activity during emotional stress may stimulate the heart asymmetrically and develop cardiac arrhythmias showing the need for meditation techniques.<sup>[29,31]</sup> Yoga is not a few postures but a holistic lifestyle which promotes health at physical, mental, emotional, and spiritual levels,<sup>[66,67]</sup> with a component of stretching, physical postures, breath control, concentration techniques which improve organ and immune function.<sup>[68]</sup> The scientific backgrounds of physiological changes have well documented in conventional rehabilitation research and can be indicative to yoga programs as well.<sup>[68,69]</sup>

Autonomic nervous system dysregulation leads to depression after CABG.<sup>[70,71]</sup>

## Limitations and future plans

Follow-up was poor even with 200 km of distance. Lack of interest from the subjects for follow-up after getting better in health was a major reason for high attrition rate. Risk factor analysis, complications, and hospitalization would have helped know the lifestyle better. We could not include the patients who wanted to change to experimental group to reach the health than the completion of work. All psychological parameters measured to ensure the role of mind in health maintenance but could not bring the cardiac measures to prove in a quantitative way.

As our treatment is home-based and self paced program, which proves that the solution is at door step. This works for high-risk population (after 5 years of CABG surgery). With all boundaries, we could get some samples from both groups for further study which ensures the interest of participants in continuation of program. Response to the phone calls and visiting at review times make sure about the interest and comfort toward the intervention. Hence, integration of physical exercises well known as conventional rehabilitation and the traditional lifestyle well known as yoga benefited the CABG patients. Patients use to demonstrate the asked practice and were replying yes for regularity. However, this was not documented. All psychological parameters measured to ensure the role of mind in health maintenance.

## Conclusion

Addition of long-term YLSP to conventional cardiac rehabilitation brings better improvement in QOL and reduction in stress levels at the end of 5 years after CABG. However, there are a large number of patients which have been lost to follow-up in the present study; hence, larger studies with better follow-up and cardiac end points are needed.

## Acknowledgements

We acknowledge all the cardiologists, cardiac surgeons and echo technicians of NIHSc, Bangaluru, for their cooperation. We thank all the therapists, Biostatistician, and staff of SVYASA for their contribution in conducting the study.

## Financial support and sponsorship

We are grateful to AYUSH, Ministry of Department of Health and Family Welfare, New Delhi, India, for funding this study.

## Conflicts of interest

There are no conflicts of interest.

## References

1. Shahian DM, O'Brien SM, Sheng S, Grover FL, Mayer JE, Jacobs JP, *et al.* Predictors of long-term survival after coronary artery bypass grafting surgery: Results from the Society of Thoracic Surgeons Adult Cardiac Surgery Database (the ASCERT study). *Circulation* 2012;125:1491-500.
2. Gonzalez AA, Dimick JB, Birkmeyer JD, Ghaferi AA. Understanding the volume-outcome effect in cardiovascular surgery: The role of failure to rescue. *JAMA Surg* 2014;149:119-23.
3. Thorén E, Kesek M, Jidéus L. The effect of concomitant cardiac resynchronization therapy on quality of life in patients with heart failure undergoing cardiac surgery. *Open Cardiovasc Med J* 2014;8:18-22.
4. Weintraub WS, Jones EL, Morris DC, King SB 3<sup>rd</sup>, Guyton RA, Craver JM. Outcome of reoperative coronary bypass surgery versus coronary angioplasty after previous bypass surgery. *Circulation* 1997;95:868-77.
5. Myler RK, Shaw RE, Stertzer SH, Zapolanski A, Zipkin R, Murphy MC, *et al.* Triple vessel revascularization: Coronary angioplasty versus coronary artery bypass surgery: Initial results and five-year follow-up. Comparative costs and loss of working days and wages. *J Invasive Cardiol* 1994;6:125-35.
6. Herlitz J, Wiklund I, Sjöland H, Karlson BW, Karlsson T, Haglid M, *et al.* Relief of symptoms and improvement of quality of life five years after coronary artery bypass grafting in relation to preoperative ejection fraction. *Qual Life Res* 2000;9:467-76.
7. Hokkanen M, Järvinen O, Huhtala H, Tarkka MR. A 12-year follow-up on the changes in health-related quality of life after coronary artery bypass graft surgery. *Eur J Cardiothorac Surg* 2014;45:329-34.
8. Järvinen O, Hokkanen M, Huhtala H. The long-term effect of perioperative myocardial infarction on health-related quality-of-life after coronary artery bypass grafting. *Interact Cardiovasc Thorac Surg* 2014;18:568-73.



9. Teo K, Lear S, Islam S, Mony P, Dehghan M, Li W, *et al.* Prevalence of a healthy lifestyle among individuals with cardiovascular disease in high-, middle- and low-income countries: The Prospective Urban Rural Epidemiology (PURE) study. *JAMA* 2013;309:1613-21.
10. Krannich JH, Weyers P, Lueger S, Herzog M, Bohrer T, Elert O. Presence of depression and anxiety before and after coronary artery bypass graft surgery and their relationship to age. *BMC Psychiatry* 2007;7:47.
11. Domanski MJ, Mahaffey K, Hasselblad V, Brener SJ, Smith PK, Hillis G, *et al.* Association of myocardial enzyme elevation and survival following coronary artery bypass graft surgery. *JAMA* 2011;305:585-91.
12. Watkins LL, Koch GG, Sherwood A, Blumenthal JA, Davidson JR, O'Connor C, *et al.* Association of anxiety and depression with all-cause mortality in individuals with coronary heart disease. *J Am Heart Assoc* 2013;2:e000068.
13. Szczepanska-Gieracha J, Morka J, Kowalska J, Kustrzycki W, Rymaszewska J. The role of depressive and anxiety symptoms in the evaluation of cardiac rehabilitation efficacy after coronary artery bypass grafting surgery. *Eur J Cardiothorac Surg* 2012;42:e108-14.
14. Kustrzycki W, Rymaszewska J, Malcher K, Szczepanska-Gieracha J, Biecek P. Risk factors of depressive and anxiety symptoms 8 years after coronary artery bypass grafting. *Eur J Cardiothorac Surg* 2012;41:302-6.
15. Freedland KE, Skala JA, Carney RM, Rubin EH, Lustman PJ, Dávila-Román VG, *et al.* Treatment of depression after coronary artery bypass surgery: A randomized controlled trial. *Arch Gen Psychiatry* 2009;66:387-96.
16. Koertge J, Weidner G, Elliott-Eller M, Scherwitz L, Merritt-Worden TA, Marlin R, *et al.* Improvement in medical risk factors and quality of life in women and men with coronary artery disease in the Multicenter Lifestyle Demonstration Project. *Am J Cardiol* 2003;91:1316-22.
17. Ornish D. Avoiding revascularization with lifestyle changes: The Multicenter Lifestyle Demonstration Project. *Am J Cardiol* 1998;82:72T-6T.
18. Denollet J, Brutsaert DL. Reducing emotional distress improves prognosis in coronary heart disease: 9-year mortality in a clinical trial of rehabilitation. *Circulation* 2001;104:2018-23.
19. Pischke CR, Scherwitz L, Weidner G, Ornish D. Long-term effects of lifestyle changes on well-being and cardiac variables among coronary heart disease patients. *Health Psychol* 2008;27:584-92.
20. Ornish D, Scherwitz LW, Doody RS, Kesten D, McLanahan SM, Brown SE, *et al.* Effects of stress management training and dietary changes in treating ischemic heart disease. *JAMA* 1983;249:54-9.
21. Raghuram N, Parachuri VR, Swarnagowri MV, Babu S, Chaku R, Kulkarni R, *et al.* Yoga based cardiac rehabilitation after coronary artery bypass surgery: One-year results on LVEF, lipid profile and psychological states – A randomized controlled study. *Indian Heart J* 2014;66:490-502.
22. Leung DY, Lam TH, Chan SS. Three versions of Perceived Stress Scale: Validation in a sample of Chinese cardiac patients who smoke. *BMC Public Health* 2010;10:513.
23. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav* 1983;24:385-96.
24. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: The PANAS scales. *J Pers Soc Psychol* 1988;54:1063-70.
25. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale. An updated literature review. *J Psychosom Res* 2002;52:69-77.
26. Rodgers J, Martin CR, Morse RC, Kendell K, Verrill M. An investigation into the psychometric properties of the Hospital Anxiety and Depression Scale in patients with breast cancer. *Health Qual Life Outcomes* 2005;3:41.
27. Harper A. WHO FTVG, the WHOQOL Group. WHOQOL-BREF: Introduction, Administration, Scoring and Generic Version of the Assessment. Geneva: WHO; 1996.
28. Martini MR, Barbisan JN. Influence of physical activity during leisure time in patients in the follow-up two years after CABG. *Rev Bras Cir Cardiovasc* 2010;25:359-64.
29. Kaliman P, Alvarez-López MJ, Cosin-Tomás M, Rosenkranz MA, Lutz A, Davidson RJ. Rapid changes in histone deacetylases and inflammatory gene expression in expert meditators. *Psychoneuroendocrinology* 2014;40:96-107.
30. Stephenson J. USPSTF: Lifestyle counseling advised for overweight, obese adults with other cardiovascular risk factors. *JAMA* 2014;312:1085.
31. Ziegelstein RC. Acute emotional stress and cardiac arrhythmias. *JAMA* 2007;298:324-9.
32. Blumenthal JA, Sherwood A, Babyak MA, Watkins LL, Waugh R, Georgiades A, *et al.* Effects of exercise and stress management training on markers of cardiovascular risk in patients with ischemic heart disease: A randomized controlled trial. *JAMA* 2005;293:1626-34.
33. Torpy JM, Burke AE, Golub RM. *JAMA* patient page. Generalized anxiety disorder. *JAMA* 2011;305:522.
34. Roger VL. Lifestyle and cardiovascular health: Individual and societal choices. *JAMA* 2009;302:437-9.
35. Oterhals K, Hanssen TA, Haaverstad R, Nordrehaug JE, Eide GE, Norekvål TM. Factors associated with poor self-reported health status after aortic valve replacement with or without concomitant bypass surgery. *Eur J Cardiothorac Surg* 2015;48:283-92.
36. Eshah NF, Bond AE, Froelicher ES. The effects of a cardiovascular disease prevention program on knowledge and adoption of a heart healthy lifestyle in Jordanian working adults. *Eur J Cardiovasc Nurs* 2010;9:244-53.
37. Kessing D, Pelle AJ, Kupper N, Szabó BM, Denollet J. Positive affect, anhedonia, and compliance with self-care in patients with chronic heart failure. *J Psychosom Res* 2014;77:296-301.
38. Wilczynska A, De Meester F, Singh Ram B, Bargiel-Matusiewicz K. Heart rate and blood pressure in the context of nutritional and psychological analysis: A case study. *Eur J Med Res* 2010;15 Suppl 2:217-23.
39. Brouwers C, Mommersteeg PM, Nyklíček I, Pelle AJ, Westerhuis BL, Szabó BM, *et al.* Positive affect dimensions and their association with inflammatory biomarkers in patients with chronic heart failure. *Biol Psychol* 2013;92:220-6.
40. Lin H, Epstein LH. Living in the moment: Effects of time perspective and emotional valence of episodic thinking on delay discounting. *Behav Neurosci* 2014;128:12-9.
41. Lipovetzky N, Hod H, Roth A, Kishon Y, Sclarovsky S, Green MS. Emotional events and anger at the workplace as triggers for a first event of the acute coronary syndrome: A case-crossover study. *Isr Med Assoc J* 2007;9:310-5.
42. Westerbotn M, Agüero-Torres H, Fastbom J, Hillerås P. A population-based study on well-being in the very old: The role of cardiovascular diseases and drugs. *Arch Gerontol Geriatr* 2005;40:287-97.
43. Macoveanu J, Rowe JB, Hornboll B, Elliott R, Paulson OB, Knudsen GM, *et al.* Playing it safe but losing anyway – Serotonergic signaling of negative outcomes in dorsomedial prefrontal cortex in the context of risk-aversion. *Eur Neuropsychopharmacol* 2013;23:919-30.



44. Knyazev GG. Extraversion and anterior vs. posterior DMN activity during self-referential thoughts. *Front Hum Neurosci* 2013;6:348.
45. Chaudhury S, Sharma S, Pawar AA, Kumar BK, Srivastava MK, Sudarsanan S, *et al.* Psychological correlates of outcome after coronary artery bypass graft. *Med J Armed Forces India* 2006;62:220-3.
46. Pischke CR, Weidner G, Elliott-Eller M, Scherwitz L, Merritt-Worden TA, Marlin R, *et al.* Comparison of coronary risk factors and quality of life in coronary artery disease patients with versus without diabetes mellitus. *Am J Cardiol* 2006;97:1267-73.
47. Versteeg H, Hoogwegt MT, Hansen TB, Pedersen SS, Zwisler AD, Thygesen LC. Depression, not anxiety, is independently associated with 5-year hospitalizations and mortality in patients with ischemic heart disease. *J Psychosom Res* 2013;75:518-25.
48. Jani BD, Cavanagh J, Barry SJ, Der G, Sattar N, Mair FS. Revisiting the J shaped curve, exploring the association between cardiovascular risk factors and concurrent depressive symptoms in patients with cardiometabolic disease: Findings from a large cross-sectional study. *BMC Cardiovasc Disord* 2014;14:139.
49. Storage S, Mandelkern MA, Phuong J, Kozman M, Neary MK, Brody AL. A positive relationship between harm avoidance and brain nicotinic acetylcholine receptor availability. *Psychiatry Res* 2013;214:415-21.
50. Nagane M, Suge R, Watanabe S. Relationship between psychosomatic complaints and circadian rhythm irregularity assessed by salivary levels of melatonin and growth hormone. *J Circadian Rhythms* 2011;9:9.
51. van Eck M, Berkhof H, Nicolson N, Sulon J. The effects of perceived stress, traits, mood states, and stressful daily events on salivary cortisol. *Psychosom Med* 1996;58:447-58.
52. Yeung A, Kiat H, Denniss AR, Cheema BS, Bensoussan A, Machliss B, *et al.* Randomised controlled trial of a 12 week yoga intervention on negative affective states, cardiovascular and cognitive function in post-cardiac rehabilitation patients. *BMC Complement Altern Med* 2014;14:411.
53. Buanes EA, Gramstad A, Søvig KK, Hufthammer KO, Flaatten H, Husby T, *et al.* Cognitive function and health-related quality of life four years after cardiac arrest. *Resuscitation* 2015;89:13-8.
54. Jolly K, Taylor RS, Lip GY, Stevens A. Home-based cardiac rehabilitation compared with centre-based rehabilitation and usual care: A systematic review and meta-analysis. *Int J Cardiol* 2006;111:343-51.
55. Lakkireddy D, Atkins D, Pillarisetti J, Ryschon K, Bommana S, Drisko J, *et al.* Effect of yoga on arrhythmia burden, anxiety, depression, and quality of life in paroxysmal atrial fibrillation: the YOGA My Heart Study. *J Am Coll Cardiol* 2013;61:1177-82.
56. Buendía F, Almenar L, Martínez-Dolz L, Sánchez-Lázaro I, Navarro J, Agüero J, *et al.* Relationship between functional capacity and quality of life in heart transplant patients. *Transplant Proc* 2011;43:2251-2.
57. Gierat-Haponiuk K, Haponiuk I, Szalewska D, Chojnicki M, Jaworski R, Niedoszytko P, *et al.* Effect of complex cardiac rehabilitation on physical activity and quality of life during long-term follow-up after surgical correction of congenital heart disease. *Kardiol Pol* 2015;73:267-73.
58. Sadeghi M, Garakyaraghi M, Khosravi M, Taghavi M, Sarrafzadegan N, Roohafza H. The impacts of cardiac rehabilitation program on echocardiographic parameters in coronary artery disease patients with left ventricular dysfunction. *Cardiol Res Pract* 2013;2013:201713.
59. Feizi A, Ghaderi C, Dehghani MR, Khalkhali HR, Sheikhi S. Effect of phase III cardiac rehabilitation and relaxation on the quality of life in patients with cardiac syndrome X. *Iran J Nurs Midwifery Res* 2012;17:547-52.
60. Szemere E, Jokeit H. Quality of life is social – Towards an improvement of social abilities in patients with epilepsy. *Seizure* 2015;26:12-21.
61. Ramadas A, Qureshi AM, Dominic NA, Botross NP, Riad A, Thirunavuk Arasoo VJ, *et al.* Socio-demography and medical history as predictors of health-related quality of life of breast cancer survivors. *Asian Pac J Cancer Prev* 2015;16:1479-85.
62. Nery RM, Barbisan JN. Effect of leisure-time physical activity on the prognosis of coronary artery bypass graft surgery. *Rev Bras Cir Cardiovasc* 2010;25:73-8.
63. Plotek W, Pielok J, Cybulski M, Samborska R. Emotional processes in patients undergoing coronary artery bypass graft surgeries with extracorporeal circulation in view of selected indicators of the inflammatory condition. *Med Sci Monit* 2015;21:105-17.
64. Pattanshetty RB, Borkar SS, Khetan SM. Effectiveness of low intensity exercises on six minute walk distance and haemodynamic variables in CABG and valve replacement patients during phase I cardiac rehabilitation in a tertiary care setup: A comparative study. *Int J Physiother Res* 2014;2:669-76.
65. Vardar Yagli N, Sener G, Arikan H, Saglam M, Inal Ince D, Savci S, *et al.* Do yoga and aerobic exercise training have impact on functional capacity, fatigue, peripheral muscle strength, and quality of life in breast cancer survivors? *Integr Cancer Ther* 2015;14:125-32.
66. Alm-Roijer C, Stagmo M, Udén G, Erhardt L. Better knowledge improves adherence to lifestyle changes and medication in patients with coronary heart disease. *Eur J Cardiovasc Nurs* 2004;3:321-30.
67. Herrick CM, Ainsworth AD. Invest in yourself. Yoga as a self-care strategy. *Nurs Forum* 2000;35:32-6.
68. Raub JA. Psychophysiological effects of Hatha Yoga on musculoskeletal and cardiopulmonary function: A literature review. *J Altern Complement Med* 2002;8:797-812.
69. Savage PD, Sanderson BK, Brown TM, Berra K, Ades PA. Clinical research in cardiac rehabilitation and secondary prevention: Looking back and moving forward. *J Cardiopulm Rehabil Prev* 2011;31:333-41.
70. Manchanda SC. Yoga – A promising technique to control cardiovascular disease. *Indian Heart J* 2014;66:487-9.
71. Dao TK, Youssef NA, Gopaldas RR, Chu D, Bakaeen F, Wear E, *et al.* Autonomic cardiovascular dysregulation as a potential mechanism underlying depression and coronary artery bypass grafting surgery outcomes. *J Cardiothorac Surg* 2010;5:36.