IHJ Cardiovascular Reports 10 (2026) 6–8

Contents lists available at ScienceDirect

IHJ Cardiovascular Reports

journal homepage: www.sciencedirect.com/journal/ihj-cardiovascular-reports

Improving cardio-metabolic health behaviours through a comprehensive lifestyle intervention program during the pandemic in India

Priya Chockalingam [a,*], S. Rajeswari [a], J. Shobika [a], R. Anantharaman [b], V. Chockalingam [c]

[a] Cardiac Wellness Institute, Chennai, India
[b] Kauvery Hospital, Chennai, India
[c] Dr. MGR Medical University, Chennai, India

ARTICLE INFO

Keywords:
Cardiovascular disorder
Cardiometabolic disease
Health behavior
Lifestyle intervention

ABSTRACT

Behavioural risk factors, causing obesity, diabetes, dyslipidemia and cardiovascular disease (CVD), have worsened during the pandemic in India. A multidisciplinary team of Physician, Physiotherapist, Dietician and Psychologist evaluated the subjects using an online questionnaire and provided a comprehensive lifestyle intervention program (CLIP) with exercise, nutrition, psychosocial counseling, health education and goal-setting components. Fifty-one subjects (54 ± 11 years, 78% male, 18 ± 7 sessions) showed significant improvement in daily intake of fruits, vegetables and whole grains, choice of heart-healthy foods between meals, weekly exercise duration, self-reported chronic stress, tobacco use and BMI. A virtual CLIP is effective in improving cardiovascular health behaviours in Indians.

1. Introduction

The absolute burden of cardiovascular disease (CVD) has increased globally and has shifted heavily toward low- and middle-income countries, with India at its epicenter.[1] Cardio-metabolic disorders, namely obesity, hypertension, diabetes and dyslipidemia are key in the causation of CVD, together contributing to the rising morbidity and mortality. Behavioural risk factors such as physical inactivity, unhealthy diet, poorly managed stress and tobacco use are at the core of the causation of these chronic diseases.[2] Unfortunately, the prolonged countrywide lockdown during the pandemic has posed a major barrier to healthy lifestyle adherence in India.[3]

The role of effective, multicomponent, evidence-based behaviour counseling interventions in promoting healthy behaviours and reducing CVD risk is well established.[4–6] The 5A Model (assess, advise, agree, assist, and arrange) provides a framework for clinical counseling that clinicians and other healthcare professionals can use for efficient lifestyle-related behavior change counseling in patients at all levels of cardiovascular disease risk at every visit.[7]

The quality and outcomes of centre-based programs focused on CVD prevention in the pre-pandemic era[8,9] and the effectiveness of home-based programs on Indians[10] have been published by our group. Research shows that the adoption of healthy behaviours is poor among Indians, mainly due to lack of intensive counseling sessions and health promotion policies.[11] This study aimed to analyze the changes in cardio-metabolic health behaviours brought about by a comprehensive lifestyle intervention program (CLIP) provided either completely virtually or in combination with centre-based, in-person sessions during the pandemic in India.

2. Methods

2.1. Subjects

All patients that participated in the CLIP for primary prevention (prevention group, PG) and secondary prevention (rehab group, RG) during the pandemic (from February 2020 to February 2023) and had completed the internally validated self-reported health behaviour assessment questionnaire, at enrolment and at completion of the CLIP, were included in this retrospective observational study. CLIP non-completers (n = 8) and questionnaire non-responders (n = 22) were excluded.

2.2. Evaluation and outcomes

Evaluation of subjects included demographic data, vitals,

* Corresponding author. No.21, 5th Avenue, Besant Nagar, Chennai, 600090, India.
E-mail address: priyachockalingam@cardiacwellnessinstitute.com (P. Chockalingam).

https://doi.org/10.1016/j.ihjcvr.2026.04.001
Received 24 July 2023; Received in revised form 27 May 2024; Accepted 16 April 2026
Available online 17 April 2026
2950-4678/© 2026 Cardiological Society of India. Published by Elsevier, a division of RELX India, Pvt. Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

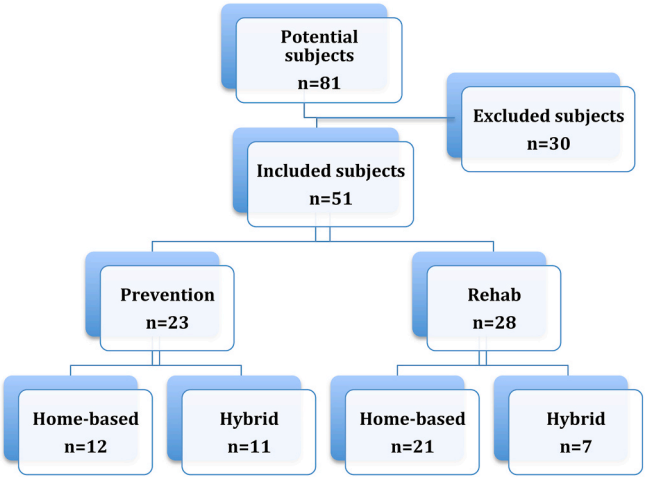


Fig. 1. Flow diagram of subjects included in the study.

anthropometry and health behavior assessment, at intake and at program completion. An online Google Forms questionnaire, consisting of 13 questions with either multiple choice or checkboxes response format, was used to evaluate the health behaviour of the subjects. The health behaviours assessed were (1) daily consumption of whole grains, (2) daily consumption of vegetables and fruits, (3) choice of foods between meals, if any, (4) weekly exercise duration, (5) self reported chronic stress and (6) tobacco use. Presence of diabetes mellitus, systemic hypertension, dyslipidemia, and overweight/obesity (body mass index, BMI $\geq$25 kg/m^2) was documented. Subjects with $\geq$2 chronic conditions were classified as multimorbid and those with left ventricular ejection fraction (LVEF) $<$ 50% were classified as heart failure (HF). The outcomes of interest were behavior modification pertaining to the 6 behaviours assessed, change in BMI and adherence to pharmacotherapy at the time of program completion.

2.3. Intervention

A multidisciplinary team consisting of Physician, Physiotherapist, Dietician and Counseling Psychologist evaluated the subjects at the time of enrolment, designed and provided a personalised and comprehensive lifestyle intervention program (CLIP) and re-evaluated them at the time of program completion. The core components of the CLIP were supervised exercise training, nutritional guidance, psychosocial counseling, health education and goal-setting based on the SMART (Specific, Measurable, Attainable, Relevant, Time-bound) goal framework to promote behaviour modification. The CLIP typically consisted of 1-2 sessions per week spread over 3-6 months.

Subjects attending all sessions online and without any in-person touch point with the healthcare team were termed the home-based group and those attending a combination of in-person and online sessions were termed the hybrid group. The home-based sessions were conducted using an online video meeting platform (Zoom/Google Meet); each session lasted about 30-45 min and with audiovisual presentation and interactive discussion components. The physiotherapist-lead online sessions were typically one-on-one while the education/counseling/nutritional sessions were small group sessions involving the subjects and their family members/caretakers. The in-person sessions were conventional face-to-face sessions in the outpatient facility. During the pandemic-related complete lockdown period, all programs were home-based; with the lifting of the lockdown, hybrid programs were offered on a request basis.

The procedures followed were in accordance with the ethical standards of the Indian Council of Medical Research and with the Declaration of Helsinki. Written informed consent was obtained from all patients at the time of enrolment. Ethical committee approval was not sought due to the retrospective nature of the study.

Table 1
Cardiovascular health behaviours in the study subjects before and after the CLIP.

Health behaviour	All subjects Pre n = 51	All subjects Post n = 51	p	Home-based subjects Pre n = 33	Home-based subjects Post n = 33	p
Consume whole-grain products on most/every day of the week, n (%)	36 (71)	45 (88)	0.01	22 (67)	28 (85)	0.04
Consume $\geq$5 cups of fruits and vegetables every day, n (%)	4 (8)	17 (33)	0.0007	3 (9)	13 (39)	0.002
Choose heart-healthy options between meals or do not eat between meals, n (%)	37 (73)	48 (94)	0.006	24 (73)	31 (94)	0.01
Weekly exercise of $\geq$150 min, n (%)	23 (45)	35 (69)	0.002	15 (45)	24 (73)	0.01
Self-reported chronic stress, n (%)	17 (33)	6 (12)	0.005	11 (33)	3 (9)	0.008
BMI, kg/m^2 (mean $\pm$ SD)	26.4 $\pm$ 5.3	25.9 $\pm$ 5.4	0.0001	25.5 $\pm$ 5.1	25 $\pm$ 5.2	0.0006

2.4. Statistical analyses

Categorical data are expressed as numbers (n) and percentages (%) and continuous data as mean and standard deviation (SD) or median and interquartile range (IQR) as applicable. Pre and post program parameters were compared using chi-sqaure test or paired *t*-test, as applicable; $p < 0.05$ was considered statistically significant.

3. Results

Age of the subjects (n = 51) was 54 $\pm$ 11 years (range 32–79 years) and 40 (78%) were male. There were 33 subjects in the home-based and 18 subjects in the hybrid group (Fig. 1). Four couples participated in the CLIP; 17 (40%) of the remaining 43 subjects had at least 1 other family member attend the majority of education/counseling sessions.

Hypertension (n = 29, 57%) and overweight/obesity (n = 29, 57%) were equally prevalent risk factors, followed by hypercholesterolemia (n = 28, 55%) and diabetes (n = 20, 40%). Majority (n = 46, 91%) had multimorbidity. In the RG (n = 28), the indication was coronary artery disease in 26 (93%) of which 13 (50%) had HF; hypertrophic cardiomyopathy and peripartum cardiomyopathy was the indication in 1 (3.5%) each.

The time between pre-program and post-program assessments was 180 days (IQR 56) and the number of sessions attended was 18 $\pm$ 7. There was a significant improvement in all the behaviours, namely

Table 2
Cardiovascular health behaviours in the Prevention and Rehab groups.

Health behaviour	Prevention Pre n = 23	Prevention Post n = 23	p	Rehab Pre n = 28	Rehab Post n = 28	p
Consume whole-grain products on most/every day of the week, n (%)	19 (83)	21 (91)	0.19	17 (61)	24 (86)	0.017
Consume ≥5 cups of fruits and vegetables every day, n (%)	2 (9)	6 (26)	0.059	2 (7)	11 (39)	0.002
Choose heart-healthy options between meals or do not eat between meals, n (%)	16 (70)	22 (96)	0.027	21 (75)	27 (96)	0.01
Weekly exercise of ≥150 min, n (%)	10 (43)	16 (70)	0.037	13 (46)	20 (71)	0.01
Self-reported chronic stress, n (%)	6 (26)	3 (13)	0.13	11 (39)	3 (11)	0.007
BMI, kg/m^2 (mean ± SD)	28 ± 6.7	27.7 ± 6.9	0.02	25 ± 3.4	24.5 ± 3.1	0.002

adequate daily intake of fruits, vegetables and whole grains, choice of heart-healthy foods between meals, sufficient weekly exercise, and a reduction in self-reported chronic stress in all subjects and in the home-based group (Table 1). Importantly, of those who used to consume unhealthy foods between meals (n = 14), all but one (n = 13, 93%) modified to healthy options. Table 2 shows the behaviour changes in the PG and RG, with significant improvement in almost all parameters.

There were significantly more tobacco users in RG than in PG (11 vs 2, p = 0.02). Of the 11 tobacco users in RG, 6 (46%) were current users at the time of cardiac diagnosis; all cigarette smokers (n = 5) quit at the time of myocardial infarction and did not relapse during the CLIP; a smokeless tobacco user presenting with chronic stable HF failed to quit.

BMI had also improved significantly in all subjects, in the home-based group and in PG and RG. Medication adherence education was provided to all subjects receiving pharmacotherapy (n = 47; 92%); failure to adhere was not reported in any of the subjects.

4. Discussion

To the best of our knowledge, this is the first study from India to report on the improvement in cardio-metabolic health behaviours brought about by a comprehensive lifestyle intervention provided virtually during the pandemic. Several evidence-based behaviour change techniques such as SMART goal-setting, physical activity prescription, self-monitoring, plate method and smoking cessation guidance were employed successfully in the CLIP.[12] Multimorbidity is a major threat to the health of our nation[13] and is best addressed by technology-enabled, easily-accessible health programs tailored to the needs of the participant[14,15] as proposed by the National Program for Prevention and Control of Cancer, Diabetes, CVD and Stroke (NPCDCS).[16]

The major limitation of the study is the small sample size but it is nevertheless useful data on the role of online behavior modification interventions, in the wake of several similar facilities completely shutting down their services during the pandemic. The lack of an externally validated health assessment questionnaire suitable for the Indian population is another limitation, which needs to be addressed in the future.

In conclusion, a comprehensive lifestyle intervention program with a multipronged approach to behaviour modification is effective in improving cardiovascular health behaviours, even in those who follow the completely home-based program.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Dr. Priya Chockalingam is the clinical director and designated partner of Cardiac Wellness Institute LLP providing CVD prevention programs in Chennai, India.

References

1. Prabhakaran D, Singh K, Roth GA, Banerjee A, Pagidipati NJ, Huffman MD. Cardiovascular diseases in India compared with the United States. *J Am Coll Cardiol.* 2018;72:79–95.
2. Mechanick JI, Farkouh ME, Newman JD, Garvey WT. Cardiometabolic-Based chronic disease, addressing knowledge and clinical practice gaps: JACC state-of-the-art review. *J Am Coll Cardiol.* 2020;75:539–555.
3. Rawat D, Dixit V, Gulati S, Gulati S, Gulati A. Impact of COVID-19 outbreak on lifestyle behaviour: a review of studies published in India. *Diabetes Metabol Syndr.* 2021;15:331–336.
4. Laddu D, Ma J, Kaar J, et al. Health behavior change programs in primary care and community practices for cardiovascular disease prevention and risk factor management among midlife and older adults: a scientific statement from the American heart association. *Circulation.* 2021;144:e533–e549.
5. Spring B, Ockene JK, Gidding SS, et al. Better population health through behavior change in adults: a call to action. *Circulation.* 2013. https://doi.org/10.1161/01.cir.0000435173.25936.e1.
6. Taylor RS, Dalal HM, McDonagh STJ. The role of cardiac rehabilitation in improving cardiovascular outcomes. *Nat Rev Cardiol.* 2022;19:180–194.
7. Kris-Etherton PM, Peterson KS, Despres JP, et al. Strategies for promotion of a healthy lifestyle in clinical settings: pillars of ideal cardiovascular health: a science advisory from the American. *Heart Association.* 2021;144:e495–e514.
8. Chockalingam P, Rajaram A, Maiya A, Contractor A. A multicentre retrospective study on quality and outcomes of cardiac rehabilitation programs in India. *Indian Heart J.* 2020;72:55–57.
9. Chockalingam P, Sakthi Vinayagam N, Ezhil Vani N, Chockalingam V. Outcomes of a multidisciplinary coronary heart disease prevention programme in southern India. *Heart Asia.* 2016;8:39–44.
10. Chockalingam P, Natarajan V, Sekar T, et al. Effectiveness of a home-based cardiovascular disease prevention program during the COVID-19 pandemic. *J Clin Prev Cardiol.* 2022;11:37–43.
11. Verma A, Mehta S, Mehta A, Patyal A. Knowledge, attitude and practices toward health behavior and cardiovascular disease risk factors among the patients of metabolic syndrome in a teaching hospital in India. *J Fam Med Prim Care.* 2019;8:178–183.
12. Hooker SA, Punjabi A, Justesen K, Boyle L, Sherman MD. Encouraging health behavior change: eight evidence-based strategies. *Fam Pract Manag.* 2018;25:31–36.
13. Patel P, Muhammad T, Sahoo H. The burden of disease-specific multimorbidity among older adults in India and its states: evidence from LASI. *BMC Geriatr.* 2023;23:53.
14. Limbachia J, Ajmeri M, Keating BJ, de Souza RJ, Anand SS. Effects of lifestyle interventions on cardiovascular risk factors in South Asians: a systematic review and meta-analysis. *BMJ Open.* 2022;12, e059666.
15. Alothman SA, Alshehri MM, Almasud AA, et al. Virtual behavioral intervention to promote healthy lifestyle behaviors: a feasibility RCT during COVID-19 pandemic. *Health Care.* 2023;11:91.
16. National programme for prevention and control of cancer, diabetes, CVD and stroke (NPCDCS). https://nhm.gov.in/index1.php?lang=1&level=2&sublinkid=1048&lid=604.