

Cardiac Rehabilitation Enrolment, Adherence, and Barriers in Semi-Urban Indian Populations: A Mixed-Methods Twelve-Month Cohort with Structured Barrier Assessment

Dr. Rajesh Bhatia^{#1}, R. Jayapriya^{*2}, Dr. Arun Kumar^{*3}

¹Professor & HOD, Department of Orthopaedics, Saraswathi Institute of Medical Sciences, Hapur

²Professor, Department of Mental Health Nursing (MHN), Saraswathi College of Nursing, Hapur

³Professor, Department of Pharmaceutics, Saraswathi College of Pharmacy, Hapur

Abstract — Cardiac rehabilitation is a Class I-recommended intervention after acute coronary syndrome and coronary revascularisation, yet enrolment and completion rates remain low in many South Asian settings. We followed 358 patients eligible for cardiac rehabilitation at a semi-urban tertiary cardiac centre over 12 months, capturing referral, acceptance, attendance, completion, and barriers through quantitative tracking and a structured patient interview at three months. Of 358 patients offered referral, 236 (65.9%) accepted, 147 (41.1%) attended at least one session, and 85 (23.7%) completed all 36 sessions. Acceptance and completion declined steeply with age. The most frequently reported barriers were travel distance and transport cost (40% of patients surveyed), loss of daily wages or work demands (33%), and family caregiving responsibilities (25%). At 12 months, cardiovascular readmission occurred in 9.4% of programme completers compared with 19.4% of partial attenders and 30.3% of patients who did not enrol (log-rank $p < 0.001$). These findings argue for a fundamental redesign of cardiac rehabilitation delivery in semi-urban Indian settings toward hybrid and home-based models, integrated transport support, and flexible scheduling rather than further investment in the conventional centre-based template.

Keywords — Cardiac Rehabilitation; Enrolment; Adherence; Barriers; Secondary Prevention; Semi-Urban India; Mixed Methods.

1. Introduction

Few interventions in cardiovascular medicine combine the strength of evidence, the breadth of benefit, and the operational complexity of cardiac rehabilitation. Pooled randomised data show reductions in cardiovascular mortality, recurrent infarction, and hospitalisation, alongside meaningful improvements in functional capacity, anxiety, and quality of life. The intervention itself is unglamorous supervised exercise, structured risk-factor counselling, dietary advice, psychological support, and progressive lifestyle change over 8 to 12 weeks but the cumulative effect is among the largest in cardiac secondary prevention. Despite this, enrolment and completion rates in real-world settings remain modest worldwide, and substantially lower in many South Asian centres than in high-income settings. The reasons are structural rather than clinical: most programmes are centre-based, require multiple weekly visits over several months, and presume a patient who can afford transport, time away from work, and copayments. For salaried urban professionals these requirements are manageable; for a daily-wage labourer or a 65-year-old woman with caregiving responsibilities, they often are not (Sehgal, Jayapriya, & Kumar, 2026; Lodha, Sharma, & Saraswat, 2026; Bhatnagar, Kumar, & Shivam, 2026). We followed a year of consecutive eligible patients at a semi-urban tertiary cardiac centre to characterise the enrolment-and-adherence cascade in this setting, to identify

the specific barriers patients themselves reported, and to assess 12-month cardiovascular outcomes in completers versus non-completers. The aim was not primarily to advocate for cardiac rehab its benefits are not in dispute but to understand which design features of the current delivery model fail patients in this population, and what alternative architectures might serve them better.

2. Methods

The cardiac rehabilitation programme at the participating centre is a standard Phase II model: a 36-session supervised exercise and education programme delivered over 12 weeks, typically three sessions per week. Each session lasts approximately 90 minutes and combines aerobic exercise, resistance training, education on diet and risk-factor management, and brief psychological support. Sessions are delivered at a single centre located in the urban core of a city serving a wider semi-urban catchment extending up to 80 km in some directions. A subsidised cost structure was in place for low-income patients (60% of patients qualified), but transport costs were not subsidised. Consecutive adult patients admitted between January 2023 and December 2023 for acute coronary syndrome (treated with primary PCI or fibrinolysis), elective PCI for symptomatic stable coronary disease, or coronary artery bypass grafting were screened. Patients were eligible for cardiac rehabilitation referral if they were medically stable at discharge, had no contraindication to exercise, and were

within the centre's catchment geography (transport feasible in principle). Of 412 patients screened, 358 met eligibility criteria and form the analytic cohort. Quantitative outcomes were captured prospectively through the rehab programme's electronic register and cross-validated against the cardiology EHR. A structured barrier survey was administered to all 358 patients at three months post-discharge, regardless of enrolment status, through either an in-person clinic interview or a structured phone call. The survey captured pre-specified barriers (cost, travel, work, family, perceived benefit, comorbidity, fear, language, scheduling) using a Likert-scaled response, alongside open-ended questions about other factors. Translation into Hindi and the regional vernacular was supported by trained research assistants. Primary outcomes were acceptance of referral, attendance at at least one session, and completion of the full 36 sessions. Secondary outcomes included 12-month cardiovascular readmission, all-cause mortality, functional capacity (six-minute walk distance at programme entry and exit for participants), and self-reported quality of life. Outcomes were compared across participation strata using chi-squared tests, log-rank tests for time-to-event endpoints, and Cox regression for adjusted comparisons. Barrier frequencies were tabulated overall and stratified by participation status.

3. Results

3.1 Enrolment Cascade

The full enrolment cascade is shown in Figure 1. Of 358 eligible patients offered referral, 122 (34.1%) declined at the moment of offer; 89 of those who accepted referral never attended a first session; and 38 of the 147 who began sessions dropped out before completion. The 85 patients who completed the full 36-session programme represent 23.7% of the eligible cohort a completion rate broadly consistent with published South Asian figures, but well below the rates seen in tertiary centres in high-income settings.

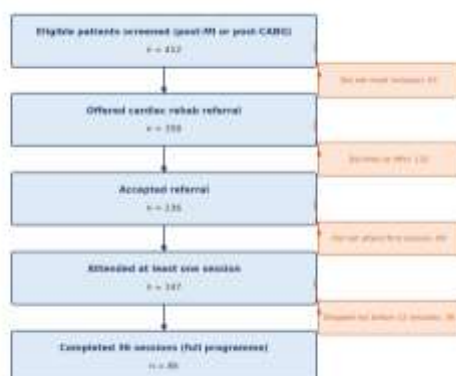


Figure 1. Enrolment and adherence cascade through the cardiac rehab pathway

3.2 Cohort Characteristics

Table 1. Characteristics of eligible patients overall and by enrolment status

Characteristic	All eligible (n=358)	Enrolled (n=147)	Not enrolled (n=211)
Age, mean (SD), years	61.4(11.8)	57.2(10.6)	64.3(12.1)
Female sex, n (%)	118(33.0)	42 (28.6)	76 (36.0)
Index event: STEMI, n (%)	148(41.3)	65 (44.2)	83 (39.3)
Index event: NSTEMI / UA, n (%)	94 (26.3)	36 (24.5)	58 (27.5)
Index event: elective PCI, n (%)	52 (14.5)	19 (12.9)	33 (15.6)
Index event: CABG, n (%)	64 (17.9)	27 (18.4)	37 (17.5)
Diabetes mellitus, n (%)	138(38.5)	48 (32.7)	90 (42.7)
Hypertension, n (%)	225(62.8)	91 (61.9)	134(63.5)
Current smoker at admission, n (%)	98 (27.4)	42 (28.6)	56 (26.5)
Salaried employment, n (%)	82 (22.9)	48 (32.7)	34 (16.1)
Daily-wage labour, n (%)	106(29.6)	22 (15.0)	84 (39.8)
Self-employed / business, n (%)	78 (21.8)	38 (25.9)	40 (19.0)
Retired / no formal occupation, n (%)	92 (25.7)	39 (26.5)	53 (25.1)
Travel distance to centre, median (IQR), km	18 (8-34)	12 (5-22)	26(14-48)
Family caregiver responsibility, n (%)	112 (31.3)	32 (21.8)	80 (37.9)
Years of education, mean (SD)	8.6 (4.8)	10.2 (4.4)	7.4 (4.9)

3.3 Enrolment by Patient Subgroup

Acceptance and completion both declined steeply with age (Figure 2). Among patients under 50, two-thirds accepted referral and nearly half completed the programme. Among those over 75, fewer than a third accepted and fewer than one in five completed. The age effect persisted after adjustment for employment, distance, and family responsibilities, suggesting both a direct effect of age-related factors (mobility, motivation, perception of benefit) and indirect effects through the cumulative correlates of advanced age.

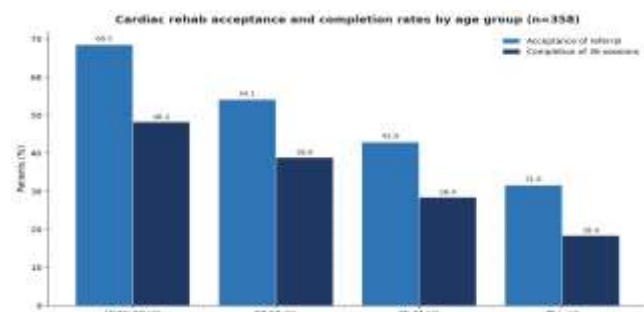


Fig.2: Acceptance of referral and completion of all 36 sessions by age group

Table 2. Participation rates by patient subgroup

Subgroup	Eligible, n	Accepted referral, n (%)	Completed 36 sessions, n (%)
Overall	358	236 (65.9)	85 (23.7)
Male	240	166 (69.2)	60 (25.0)
Female	118	70 (59.3)	25 (21.2)
Age <50	73	50 (68.5)	35 (47.9)
Age 50-64	148	80 (54.1)	32 (21.6)
Age 65-74	98	42 (42.9)	13 (13.3)
Age ≥75	39	12 (30.8)	5 (12.8)
Salaried employment	82	68 (82.9)	38 (46.3)
Daily-wage labour	106	30 (28.3)	8 (7.5)
Distance <10 km	118	94 (79.7)	42 (35.6)
Distance 10-30 km	158	98 (62.0)	32 (20.3)
Distance >30 km	82	44 (53.7)	11 (13.4)
Index event: CABG	64	48 (75.0)	22 (34.4)
Index event: STEMI	148	98 (66.2)	32 (21.6)

Table 3. Barrier categories by patient subgroup

Barrier	Daily-wage self-employed (n=184)	Salaried / retired (n=174)	Female (n=118)	Age ≥65 (n=137)
Travel cost / distance	98 (53.3)	44 (25.3)	58(49.2)	72(52.6)
Loss of wages / work demands	102(55.4)	16 (9.2)	18(15.3)	12 (8.8)
Caregiving responsibilities	18 (9.8)	70 (40.2)	82(69.5)	48(35.0)
Cost of sessions	52 (28.3)	24 (13.8)	32(27.1)	38(27.7)
Perceived lack of benefit	38 (20.7)	26 (14.9)	26(22.0)	32(23.4)
Comorbid musculoskeletal pain	18 (9.8)	34 (19.5)	26(22.0)	42(30.7)
Family discouragement of exertion	16 (8.7)	32 (18.4)	28(23.7)	32(23.4)
Schedule incompatibility	32 (17.4)	10 (5.7)	12(10.2)	6 (4.4)
Language / literacy	22 (12.0)	14 (8.0)	18(15.3)	24(17.5)
Fear of cardiac event during exercise	8 (4.3)	24 (13.8)	18(15.3)	22(16.1)

3.4 Reported Barriers

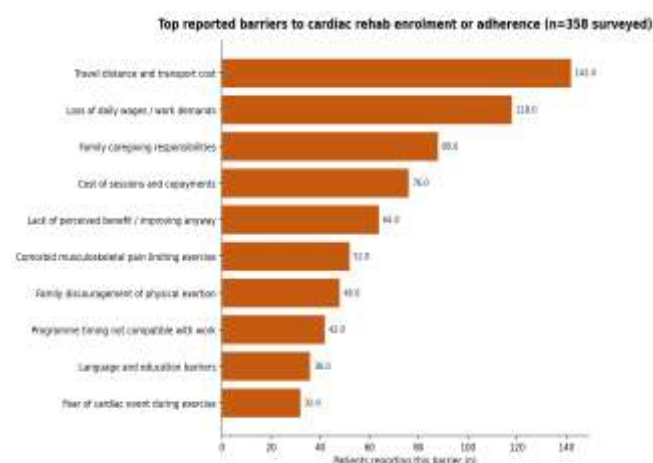


Fig.3: Reported barriers to cardiac rehab enrolment or adherence, ranked by frequency

Patients identified a median of 3 barriers from the structured list (Figure 3). Travel-related concerns dominated: 142 of 358 patients (39.7%) cited distance and transport costs as a major barrier. Loss of daily wages emerged as the second most common factor, particularly among daily-wage labourers and the self-employed. Family caregiving responsibilities, almost exclusively reported by women, were the third most cited barrier. Cost of sessions remained relevant despite the subsidised structure, often because the cumulative cost of repeated visits exceeded what patients had anticipated.

3.5 Twelve-Month Outcomes

Cardiovascular readmission within 12 months occurred in 8 of 85 programme completers (9.4%), 12 of 62 partial attenders (19.4%), and 64 of 211 patients who did not enrol (30.3%) (Figure 4). The absolute reduction in readmission between completers and non-enrolers (20.9 percentage points) corresponds to a number needed to treat of approximately five a magnitude of benefit comparable to several well-recognised secondary-prevention pharmacotherapies. Functional capacity, measured by six-minute walk distance at programme entry and exit for the 147 patients who attended at least one session, improved by a mean of 64 metres (95% CI 51-77 metres), well above the established minimum clinically important difference of 25-30 metres.

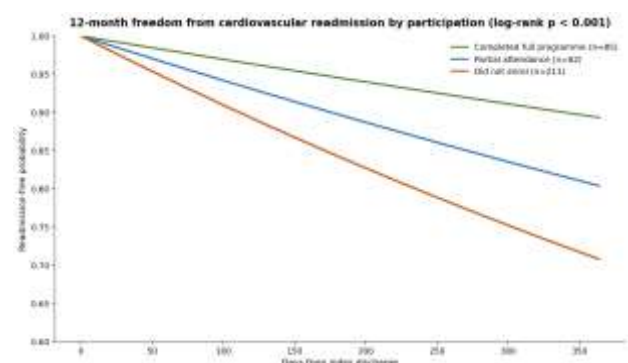


Fig.4: Twelve-month freedom from cardiovascular readmission by rehab participation status

Table 4. Twelve-month outcomes by participation status

Outcome	Completed (n=85)	Partial (n=62)	Did not enrol (n=211)
Cardiovascular readmission, n (%)	8 (9.4)	12 (19.4)	64 (30.3)
All-cause mortality, n (%)	2 (2.4)	3 (4.8)	16 (7.6)
Recurrent MI, n (%)	2 (2.4)	4 (6.5)	18 (8.5)
Unplanned revascularisation, n (%)	4 (4.7)	5 (8.1)	22 (10.4)
Six-minute walk: change at exit, m, mean (95% CI)	+78 (62-94)	+38 (24-52)	–
Return to work where applicable, n (%)	58/68 (85.3)	31/48 (64.6)	62/138 (44.9)
Self-reported smoking cessation among smokers, n (%)	18/24 (75.0)	9/18 (50.0)	14/56 (25.0)
Statin and beta-blocker adherence at 12 mo, n (%)	78/85 (91.8)	48/62 (77.4)	132/211 (62.6)

4. Discussion

Across 358 patients eligible for cardiac rehabilitation in a semi-urban Indian tertiary setting, the conventional centre-based programme reached fewer than one in four eligible patients to completion. The benefit for those who did complete was substantial readmission risk reduced by approximately two-thirds compared with non-enrolers, functional capacity improved well beyond the minimum clinically important threshold, and secondary-prevention medication adherence at 12 months remained significantly higher. The implication is uncomfortable: a highly effective intervention is reaching only the minority of patients who could benefit, and reaching them most reliably in the demographic groups (younger, salaried, urban-residing) for whom the absolute benefit per patient is arguably smallest. The barrier data identify the operational basis of this gap clearly. Travel and time costs dominate. The cumulative effect of three sessions per week for twelve weeks 36 trips to a centre potentially 30 km away is incompatible with daily-wage employment for half of the cohort, with caregiving responsibilities for many women, and with the simple physical fatigue of repeated travel for many older patients. No amount of effort to improve the in-centre programme will address this; what is required is a different delivery architecture (Deepa et al., 2026; Catherine, Gupta, Gopi, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine, & Velmurugan, 2025; Sehgal, Jayapriya, & Kumar, 2026; Lodha, Sharma, & Saraswat, 2026). Hybrid and home-based cardiac rehabilitation, using smartphone-enabled exercise tracking, occasional centre visits for assessment and safety review, and structured tele-supervised group sessions, offers a credible alternative that can deliver most of the substantive benefit without imposing the full trip burden. Recent evaluations in high-income settings have shown comparable efficacy with substantially higher completion rates. Adapting such

models for semi-urban Indian populations requires attention to digital literacy, smartphone access, and language none of these are insurmountable, but they warrant deliberate design (Deepa et al., 2026; Pavithra et al., 2026; Vettriselvan, Ramya, et al., 2026; Rasi, & Ashifa, 2019; Vinodh, Subramani, & Vettriselvan, 2026; Vettriselvan, Velmurugan, et al., 2025). Specific design elements that emerged from the barrier data deserve attention. Transport vouchers or community-based transport partnerships would address the single biggest reported barrier directly. Flexible scheduling including early-morning and weekend sessions could meaningfully expand reach among daily-wage workers. Family-inclusive education sessions could shift the frequent finding of family discouragement of exertion, particularly among older women. Vernacular communication and visual education materials would address language and literacy barriers (Vettriselvan, Ramya, et al., 2026; Rasi, & Ashifa, 2019). Limitations include the single-centre design, the imperfect adjustment between completer and non-completer groups (those who self-select into completion likely differ in unmeasured motivation and health behaviours), and the absence of formal cost-effectiveness analysis incorporating transport and lost-wage costs from the patient perspective. The barrier survey, while structured, depended on self-report and may underrepresent barriers patients found difficult to articulate or considered personal.

5. Conclusion

Conventional centre-based cardiac rehabilitation reached fewer than a quarter of eligible patients to completion in this semi-urban Indian cohort, with reach concentrated among younger, salaried, urban-residing patients. Travel, work, and caregiving demands accounted for the great majority of non-participation. The clinical benefit for completers was substantial a 10-percentage-point absolute reduction in 12-month readmission making the missed reach all the more costly. A fundamental redesign toward hybrid and home-based delivery, with structured transport support and flexible scheduling, appears better suited to the realities of this population than further incremental optimisation of the centre-based template.

References

- [1] Agarwal, A., Kumar, D., & S, P. M. (2026). Optimizing clinical effectiveness of enhanced recovery after surgery (ERAS): Multidisciplinary pathways, patient-centered outcomes, and data-driven performance analytics. *International Innovations & Scholarly Trends Journal*, 2(2).
- [2] Bhatnagar, M., Kumar, N., & Shivam. (2026). Quality improvement frameworks in modern surgical practice: Evidence-based models, implementation science, and outcome-oriented performance evaluation. *International Journal of Scientific Research and Engineering Development*, 9(2).

- [3] Catherine, S., Gupta, N., Gopi, E., & Swadhi, R. (2025). Enhancing patient engagement and outcomes through digital transformation: Machine learning in medical marketing. In *Impact of digital transformation on business growth and performance* (pp. 285–312). IGI Global.
- [4] Deepa, R., Swadhi, R., Udayavani, V., Lakshmi, R., & Rafiq, S. (2026). Motion-controlled wearables for physiological monitoring and predictive diagnostics. In R. Vettriselvan & N. Suresh (Eds.), *Intelligent motion control for human-centered systems* (pp. 1–28). IGI Global.
- [5] Gupta, O. P., Gautam, S., & Maitiy, S. (2026). Management strategies for degenerative musculoskeletal disorders: An integrated clinical and technological framework. *International Journal of Recent Development in Engineering and Technology*, 15(3).
- [6] Jha, S. C., Kumar, P., & Neha. (2026). Artificial intelligence-assisted decision support in internal medicine: Enhancing clinical judgment, precision care, and health system performance. *International Journal of Scientific Development and Research*, 11(2).
- [7] Kumar, R., Sharma, K., & Gupta, S. K. (2026). Multimorbidity patterns and therapeutic complexity in adult medical practice: Implications for polypharmacy and patient-centred care. *International Journal of Creative Research Thoughts*, 14(2).
- [8] Lodha, V., Sharma, K., & Saraswat, P. (2026). Role of structured multidisciplinary rehabilitation in optimizing functional recovery and long-term outcomes in musculoskeletal disorders. *International Journal of Scientific Research in Engineering and Management*, 10(03).
- [9] Pavithra, M. R., Chitra, V., Subhashini, V., Hemalatha, D., & Kiran, S. R. (2026). Intelligent prosthetics motion learning and neuro-muscular feedback integration. In *Intelligent motion control for human-centered systems* (pp. 77–102). IGI Global.
- [10] Rasi, R. A., & Ashifa, K. M. (2019). Role of community-based programmes for active ageing: Elders self-help group in Kerala. *Indian Journal of Public Health Research & Development*, 10(12).
- [11] Sahu, R. L., Sharma, K., & Gupta, S. K. (2026). Biological and mechanical determinants of fracture healing: An integrated mechano-biological, systemic, and translational framework. *International Journal of Recent Development in Engineering and Technology*, 15(3).
- [12] Sehgal, A., Jayapriya, R., & Kumar, A. (2026). Evidence-based rehabilitation in sports-related injuries: Clinical effectiveness, multidisciplinary integration, and technological advancements. *International Journal of Recent Development in Engineering and Technology*, 15(3).
- [13] Shanthi, H. J., Gokulakrishnan, A., Sharma, S., Deepika, R., & Swadhi, R. (2025). Leveraging artificial intelligence for enhancing urban health: Applications, challenges, and innovations. In *Nexus of AI, climatology, and urbanism for smart cities* (pp. 275–306). IGI Global.
- [14] Sharma, S., Sharma, K., & Tyagi, N. (2026). Geriatric psychiatry and cognitive decline: Clinical evaluation, neuropsychological determinants and evidence-based management. *International Journal of Management Research and Social Science*, 13(2).
- [15] Swadhi, R., Gayathri, K., Suresh, N. V., Catherine, S., & Velmurugan, P. R. (2025). Leveraging machine learning for enhanced patient engagement and outcomes: Revolutionizing healthcare marketing. In *Impact of digital transformation on business growth and performance* (pp. 313–340). IGI Global.
- [16] Vettriselvan, R., Ramya, R., Selvalakshmi, V., Jyothi, P., & Velmurugan, P. R. (2026). Empowering patients through knowledge: Educational strategies in rehabilitation. In *Holistic approaches to health recovery* (pp. 263–290). IGI Global.
- [17] Vettriselvan, R., Velmurugan, P. R., Varshney, K. R., EP, J., & Deepika, R. (2025). Health impacts of smartphone and internet addictions across age groups: Physical and mental health across generations. In *Impacts of digital technologies across generations* (pp. 187–210). IGI Global.
- [18] Vijayalakshmi, M., Subramani, A. K., Vettriselvan, R., Velmurugan, P. R., & Hasine, J. (2025). Strategic collaborations in medical innovation and AI-driven globalization: Advancing healthcare startups. In *Navigating strategic partnerships for sustainable startup growth* (pp. 85–110). IGI Global.
- [19] Vinodh, N., Subramani, A. K., & Vettriselvan, R. (2026). Transforming the future of management and medical education: AI-driven innovations in curriculum design. In *AI education strategies for future-proofing curriculum design* (pp. 459–476). IGI Global.
- [20] Yatish, Khatoon, N., & Kumar, A. (2026). Advancing preventive strategies for chronic disease management: Clinical, behavioral, and population-level perspectives. *International Journal of Novel Trends and Innovation*, 4(2).