



Efficacy of an mHealth-guided tailored physical activity intervention on exercise tolerance and sedentary behaviour in ischaemic heart disease: A prospective cohort study

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Abstract

Background: Ischaemic heart disease (IHD) remains a preeminent cause of global mortality [6]. The progressive nature of coronary atherosclerosis necessitates nuanced clinical interventions involving structured physical activity [7]. This study investigates the complex intersection of residential living conditions, baseline cardiovascular pathophysiology and the efficacy of an individualised, mobile health (mHealth)-guided physical activity program among patients diagnosed with IHD [8,13].

Materials and Methods: This prospective cohort study was conducted at the Tashkent State Medical University clinic, enrolling 183 patients (98 men, 85 women; mean age 64.2 ± 5.1 years) diagnosed with stable exertion angina pectoris (functional class II-III). Patients were categorised into urban ($n = 89$) and rural ($n = 94$) cohorts. Subjective baseline activity was assessed using the ODA-23+ questionnaire and daily diaries, while objective exercise tolerance was evaluated via cycle ergometry [3,5]. Following baseline assessments, patients were prescribed a tailored exercise regimen managed via the 'HealthRunApp' and followed up at 6 months [30–32].

Results: At baseline, arterial hypertension was highly prevalent (84.3% urban, 80.8% rural). Daily diaries revealed profound sedentarism; urban men averaged 11.4 ± 1.8 hr of sleep per day, while rural women averaged 5.7 ± 0.7 hr of television viewing. Subjective assessments demonstrated massive overestimation of physical condition: 64.7% of rural men self-rated their activity as medium to high [10,29]. However, objective cycle ergometry revealed that 80% of urban patients possessed low or very low exercise tolerance. Following the 6-month mHealth intervention, cycle ergometry duration significantly increased ($p < 0.001$), total work volume improved dramatically across all cohorts ($p < 0.01$) and ischaemic indicators significantly decreased ($p < 0.001$).

Conclusion: While a severe baseline disconnect exists between self-perceived health literacy and objective physiological tolerance among IHD patients, the introduction of a tailored, continuously monitored mHealth cardiac rehabilitation programme successfully combats hypodynamia, safely improves exercise tolerance and enhances objective motor activity across both urban and rural demographics [6,27,29,34].

Keywords

coronary artery disease, angina, stable, exercise tolerance, sedentary behaviour, cardiac rehabilitation, telemedicine, rural population, urban population

Introduction

Ischaemic heart disease (IHD) remains the undisputed preeminent cause of global mortality, representing a central and escalating challenge within the landscape of modern cardiovascular epidemiology [6]. The progressive, insidious nature of coronary atherosclerosis, which typically culminates in stable exertion angina pectoris, necessitates highly nuanced and multifaceted clinical interventions [7]. These interventions must inherently extend far beyond the conventional boundaries of pharmacological management or acute revascularisation to

encompass comprehensive, long-term lifestyle engineering and rigorous physical activity modifications [9].

The demographic and socioeconomic transition currently experienced in Central Asia is of immense epidemiological significance, shifting the burden from communicable diseases toward an aging population facing exponential rises in non-communicable, atherosclerotic diseases [6]. Evaluating physical activity levels and sedentary behaviour in this demographic is critical, as hypodynamia fundamentally drives atherogenic dyslipidemia and the progression of chronic coronary syndromes [9,24–26,34].

However, accurately assessing physical activity remains challenging [12]. Subjective reporting often differs significantly from objective physiological thresholds, confounding risk stratification. This clinical study presents a highly detailed, geographically and culturally specific cohort investigation into the complex intersection of structured and unstructured physical activity, residential living conditions and cardiovascular pathophysiology. By meticulously delineating the clinical manifestations of stable angina pectoris

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across distinct urban and rural demographics, this research provides a critical, high-resolution lens into the socio-behavioural determinants of cardiovascular health [9].

The primary objective is to first quantify the cognitive dissonance between subjective health perceptions and objective exercise tolerance and subsequently evaluate the clinical efficacy of a personalised, mobile-guided cardiac rehabilitation intervention.

Materials and methods

1. Study design and population

This prospective cohort study was conducted between 2020 and 2022 across the specialised departments of cardiology, cardio-rehabilitation and therapy within the multidisciplinary clinic of Tashkent State Medical University [6]. A total of 183 patients (98 men, 85 women; mean age 64.2 ± 5.1 years) diagnosed with IHD and stable exertion angina pectoris [functional class (FC)-II-III] were enrolled [6]. FC was defined by the Canadian Cardiovascular Society (CCS) grading scale, ensuring all participants were ambulatory and theoretically capable of participating in outpatient cardiac rehabilitation programs.

2. Participant eligibility

Inclusion criteria

Patients were eligible for inclusion if they met the following criteria:

1. Age between 40 years and 79 years.
2. Confirmed diagnosis of IHD with stable exertion angina pectoris, classified as FC-II or FC-III according to the CCS grading scale [6].
3. Concomitant, pharmacologically controlled arterial hypertension (Stage 1 or 2).
4. Physical and cognitive ability to utilise a mobile smartphone application and perform home-based walking exercises.

Exclusion criteria

Patients with the following conditions were excluded:

1. Acute forms of coronary artery disease, unstable angina or CCS Class IV stable angina.
2. Chronic heart failure classified as New York Heart Association FC-III or FC-IV.
3. Left ventricular aneurysm.
4. Uncontrolled stage 3 arterial hypertension.
5. High-risk cardiac arrhythmias and conduction disorders, including atrial fibrillation or flutter, multifocal or coupled ventricular extrasystoles and second- or third-degree atrioventricular blocks.
6. History of acute cerebrovascular accident, transient ischaemic attack or thromboembolism within the preceding 6 months.
7. Severe concurrent musculoskeletal, pulmonary, hepatic or renal impairment.
8. Type 1 or type 2 diabetes mellitus.

3. Group distribution and baseline clinical profile

To assess environmental and geographic determinants of health behaviour, patients were divided into two distinct cohorts based on primary residential living conditions:

- **Group 1 (Urban):** 89 patients (47 men, 42 women) living in urban conditions.
- **Group 2 (Rural):** 94 patients (51 men, 43 women) living in rural conditions.

Baseline demographics, clinical characteristics and hemodynamic profiles are consolidated in Table 1.

According to anamnestic data, none of the patients included in the study were actively employed in state enterprises, and consequently, they spent the overwhelming majority of their time at home [2]. Group 2 (Rural) displayed an even more severe hemodynamic profile, featuring an average SBP of 156.9 ± 16.0 mmHg and a DBP of 94.5 ± 10.1 mmHg. These metrics remain persistently above the optimal therapeutic target of $<130/80$ mmHg strictly recommended for the secondary prevention of cardiovascular events [1].

4. Assessment tools and baseline evaluations

Subjective physical activity (ODA-23+ Questionnaire & diaries)

Subjective physical activity was evaluated using the 'ODA-23+' (Movement Activity Questionnaire), a validated 23-item psychometric tool designed for IHD patients [3,5]. The questionnaire was translated and culturally adapted into the Uzbek language [5]. Each response is assigned a specific point value, and cumulative scores categorise activity into five clinical levels: very low (≤ 45 points), low (46–74 points), medium (75–100 points), high (101–125 points) and very high (>125 points) [5]. Subjective data were supplemented by patient diaries tracking daily hours spent sleeping, watching television and performing light physical activities. Physical activity in the form of walking and light physical exercises is two times higher in rural men than in women, while this indicator is almost the same in urban residents.

Objective exercise tolerance (cycle ergometry)

Objective exercise tolerance was assessed using a Kettle-ergometer RX1 cycle ergometer (Germany). Stepwise continuous loads were increased by 25 W (150 kg-m/min) every 3 min. The test was terminated upon reaching submaximal heart rate or clinical criteria (angina, SBP ≥ 180 mmHg, severe dyspnoea or ECG changes). Exercise tolerance was categorised based on peak achieved workload: very low (150 kg-m/min), low (300 kg-m/min), moderate (450–600 kg-m/min) or high (≥ 750 kg-m/min). Total work volume (TWV) in kg-m was calculated as:

$$TWV = \sum (\text{workload power in kg-m/min} \times \text{duration in minutes})$$

5. Personalised mHealth intervention (HealthRunApp)

Following baseline testing, an individualised 'Dosed Walking Exercise' programme was calculated for each patient. The walking

Table 1 - Baseline demographics and clinical characteristics of the study population

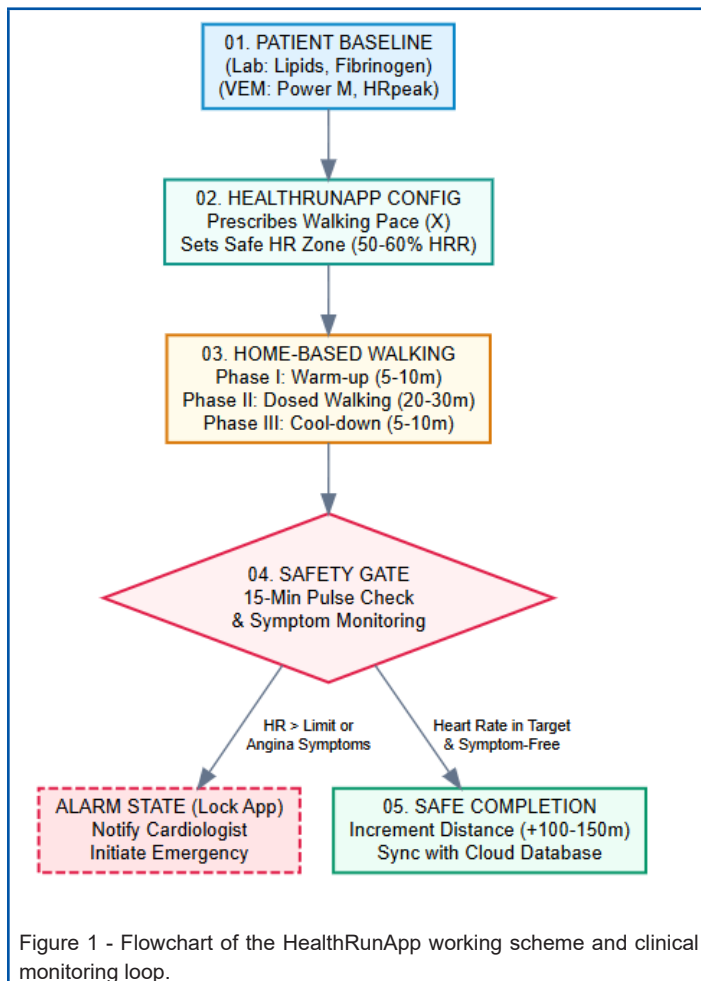
Clinical feature	Group 1 (Urban, n = 89)	Group 2 (Rural, n = 94)	p-value
Average age (years)	65.4 ± 4.3	63.7 ± 5.1	>0.05
Male, n (%)	47 (52.8)	51 (54.3)	>0.05
Female, n (%)	42 (47.2)	43 (45.7)	>0.05
Stable angina CCS FC II, n (%)	11 (12.4)	8 (8.5)	>0.05
Stable angina CCS FC III, n (%)	78 (87.6)	86 (91.5)	>0.05
Duration of IHD (years)	4.2 ± 0.33	3.6 ± 0.26	>0.05
Arterial hypertension, n (%)	75 (84.3)	76 (80.8)	>0.05
Systolic BP (mmHg)	148.9 ± 11.2	156.9 ± 16.0	<0.05
Diastolic BP (mmHg)	96.2 ± 13.5	94.5 ± 10.1	>0.05
BMI (kg/m ²)	30.8 ± 4.52	29.7 ± 3.91	>0.05
Waist circumference (cm)	111.8 ± 13.6	118.7 ± 18.4	<0.05
Active smoking, n (%)	21 (23.6)	29 (30.8)	>0.05

BMI, body mass index; CCS, Canadian Cardiovascular Society; FC, functional class; IHD, ischaemic heart disease.

Table 2 - Physical activity program based on FCs of coronary artery disease

Type of physical activity	FC-I	FC-II	FC-III
General developmental exercises (min)	35–45	25–35	20–30
Dosed walking exercise (min)	30	20–30	20
Breathing exercises	+++	+++	+++
Slow walking exercises (km)	2.5–3.0	2.0–2.5	1.5–2.0

FC, functional class.



pace (X, in steps per minute) was computed using the Nikolaeva–Aronov formula:

$$X = 0.042 \cdot M + 0.15 \cdot \text{HR}_{\text{peak}} + 65.5$$

where M is the threshold workload power (kg-m/min) and HR_{peak} is the peak heart rate achieved during baseline cycle ergometry.

The prescribed program was managed via the 'HealthRunApp' mobile application [30–32]. The daily routine (4–6 times per week) consisted of:

- Warm-up (5–10 min):** General developmental and light gymnastic exercises.
- Conditioning phase (20–30 min):** Dosed walking at the target pace (X).
- Cool-down (5–10 min):** Slow walking and breathing exercises [7].

The distance started at 500 m and graduated by 100–150 m daily up to targets of 2.5–3.0 km (FC I), 2.0–2.5 km (FC II) and 1.5–2.0 km (FC III). To ensure safety, a training heart rate zone (50%–60% of heart rate reserve) was programmed. Patients logged their pulse 10–15 min into walking, and the app generated clinical safety alerts if limits were exceeded. The program supports an individual approach for each patient, it is prescribed by the doctor taking into account baseline parameters [6]. The interactive, clinical workflow of the program is illustrated in Figure 1.

Table 3 - Baseline daily activity budgets (hours per day).

Daily activity index	Urban men (n = 47)	Urban women (n = 42)	Rural men (n = 51)	Rural women (n = 43)
Sleep (nocturnal and daytime)	11.4 ± 1.8	10.2 ± 2.1	10.4 ± 1.8	11.6 ± 1.8
Watching television	5.3 ± 0.8	4.8 ± 0.9	4.2 ± 0.8	5.7 ± 0.7
Light physical activity (walking, light exercise)	2.2 ± 0.5	2.5 ± 0.6	3.4 ± 0.5	1.5 ± 0.4

Table 4 - Baseline subjective physical activity levels (ODA-23+ Questionnaire).

Subjective activity level	Urban men (n = 47)	Urban women (n = 42)	Rural men (n = 51)	Rural women (n = 43)
High	7 (14.9%)	4 (9.5%)	9 (17.6%)	5 (11.6%)
Medium	21 (44.7%)	19 (45.3%)	24 (47.1%)	19 (44.1%)
Low	15 (31.9%)	14 (33.3%)	13 (25.5%)	16 (37.3%)
Very low	4 (8.5%)	5 (11.9%)	5 (9.8%)	3 (7.0%)

Table 5 - Baseline objective exercise tolerance levels based on cycle ergometry

Objective exercise tolerance	Urban men (n = 47)	Urban women (n = 42)	Rural men (n = 51)	Rural women (n = 43)
Moderate (450–600 kg-m/min)	11 (23.4%)	5 (11.9%)	15 (29.4%)	5 (11.6%)
Low (300 kg-m/min)	25 (53.2%)	21 (50.0%)	29 (56.9%)	19 (44.2%)
Very low (150 kg-m/min)	11 (23.4%)	16 (38.1%)	7 (13.7%)	19 (44.2%)
High (≥750 kg-m/min)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 6 - Subjective versus objective physical activity disparity matrix

Demographic cohort	Subjective medium/high rate (%)	Objective medium/high rate (%)	Patients overestimating capacity (%)
Urban men (n = 47)	59.6	23.4	36.2
Urban women (n = 42)	54.8	11.9	42.9
Rural men (n = 51)	64.7	29.4	35.3
Rural women (n = 43)	55.7	11.6	44.1

6. Adherence, dropouts and compliance

Compliance was monitored through daily application logs and weekly telephone follow-ups by a clinical coordinator. High adherence was defined as completing ≥80% of prescribed weekly sessions. Out of 183 patients initially enrolled, all 183 successfully completed the 6-month study (100% retention; 0% attrition).

7. Statistical analysis

Data were analyzed using Microsoft Excel-2016 and STATISTICA 6.0. Continuous variables are expressed as mean ± standard deviation and categorical variables as percentages (%). Normality was confirmed using the Kolmogorov–Smirnov test. Intra-group pre- and post-intervention changes were assessed using the paired Student's *t*-test. Inter-group baseline and follow-up differences were compared using the independent *t*-test. Categorical variables were evaluated using the Chi-squared (χ^2) test. Bivariate correlations between physical activity, haemodynamic parameters and biomarkers were calculated using Pearson's or Spearman's correlation coefficients (*r*). Statistical significance was defined as $p < 0.05$.

Results

8. Daily activities and sedentary behaviours

Analysis of baseline daily diaries revealed severe sedentarism in both cohorts, with patients spending 2–3 times more hours in passive recumbency than in physical exertion (Table 3).

When asked about post-meal time allocation, urban residents consistently reported spending most of their time praying, reading books and helping grandchildren prepare for school. Rural residents reported spending most of their time talking to relatives and neighbors.

9. Subjective and objective baseline disparities (cognitive dissonance)

Subjective ODA-23+ questionnaire scores showed that nearly 2/3 of patients self-rated their physical activity as medium to high (Table 4) [5,29].

However, objective cycle ergometry demonstrated a severe overestimation of physical capacity. Up to 80% of urban patients and 78.7% of rural patients actually had low or very low exercise tolerance (Table 5).

Comparing subjective and objective data revealed a stark disconnect in patients' self-perception (Table 6) [19,29].

10. 6-month post-intervention outcomes

Following the 6-month mobile health (mHealth)-guided program, patients showed significant functional, haemodynamic and biochemical improvements [5]. Subjective ODA-23+ scores increased 1.5-fold in urban men, 1.6-fold in urban women, 1.4-fold in rural men and 1.7-fold in rural women ($p < 0.01$).

Table 7 - Pre- and post-intervention changes in TWV (kg-m)

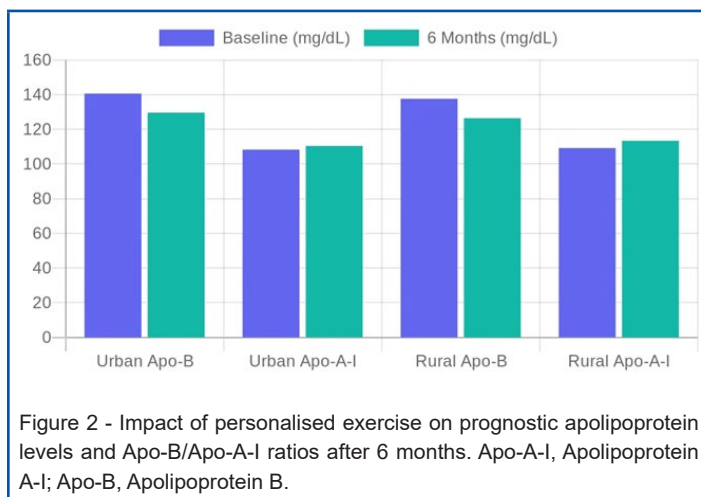
Patient group	Baseline TWV (kg-m)	6-Month TWV (kg-m)	Relative increase	p-value
Urban men (n = 47)	1841.3 ± 153.5	3452.4 ± 285.7	1.87x	<0.01
Urban women (n = 42)	1647.8 ± 173.6	2706.4 ± 241.1	1.64x	<0.05
Rural men (n = 51)	1916.8 ± 214.2	3374.0 ± 285.6	1.76x	<0.05
Rural women (n = 43)	1506.7 ± 174.1	2965.4 ± 209.8	1.97x	<0.01

TWV, total work volume.

Table 8 - Cycle ergometry and hemodynamic parameters initially and at 6 months

Parameter	Urban cohort (n = 89)		Rural cohort (n = 94)	
	Baseline	6 months	Baseline	6 months
Ergometry duration (min)	4.16 ± 0.08	7.21 ± 0.14***	5.04 ± 0.09	7.43 ± 0.19***
Resting heart rate (bpm)	76.2 ± 5.8	63.5 ± 4.3	68.7 ± 7.1	63.4 ± 4.7
Peak heart rate (bpm)	129.5 ± 9.1	102.4 ± 8.3*	133.7 ± 10.2	98.6 ± 7.9*
Resting SBP (mmHg)	128.2 ± 10.2	119.2 ± 10.2	136.7 ± 11.0	123.8 ± 10.9
Peak SBP (mmHg)	159.7 ± 14.2	139.4 ± 11.3	165.8 ± 13.4	141.3 ± 11.7
Resting DBP (mmHg)	96.2 ± 8.5	85.8 ± 6.1	94.5 ± 8.1	84.5 ± 7.3
Peak DBP (mmHg)	105.7 ± 9.6	97.9 ± 7.4	107.6 ± 9.1	97.7 ± 8.6
ST-segment shift (mm)	1.6 ± 0.07	1.1 ± 0.03***	1.9 ± 0.09	1.3 ± 0.04***
Supraventricular extrasystoles (beats/24 hr)	24.5 ± 2.1	8.4 ± 0.28***	54.8 ± 3.4	18.1 ± 2.7***
Ventricular extrasystoles (beats/24 hr)	10.8 ± 1.1	0.5 ± 0.06***	35.7 ± 2.7	1.7 ± 0.07***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ compared to baseline.



Objective physical fitness, assessed via cycle ergometry, improved dramatically. TWV increased 1.7-fold in Group 1 and 18.-fold in Group 2 ($p < 0.01$) (Table 7).

Furthermore, cycle ergometry and 24-hr Holter monitoring demonstrated substantial reductions in myocardial ischaemia, resting heart rate and pathological arrhythmias ($p < 0.001$) (Table 8). Additionally, 25 patients (15.2% of the overall cohort) clinically transitioned from FC-III to FC-II stable angina.

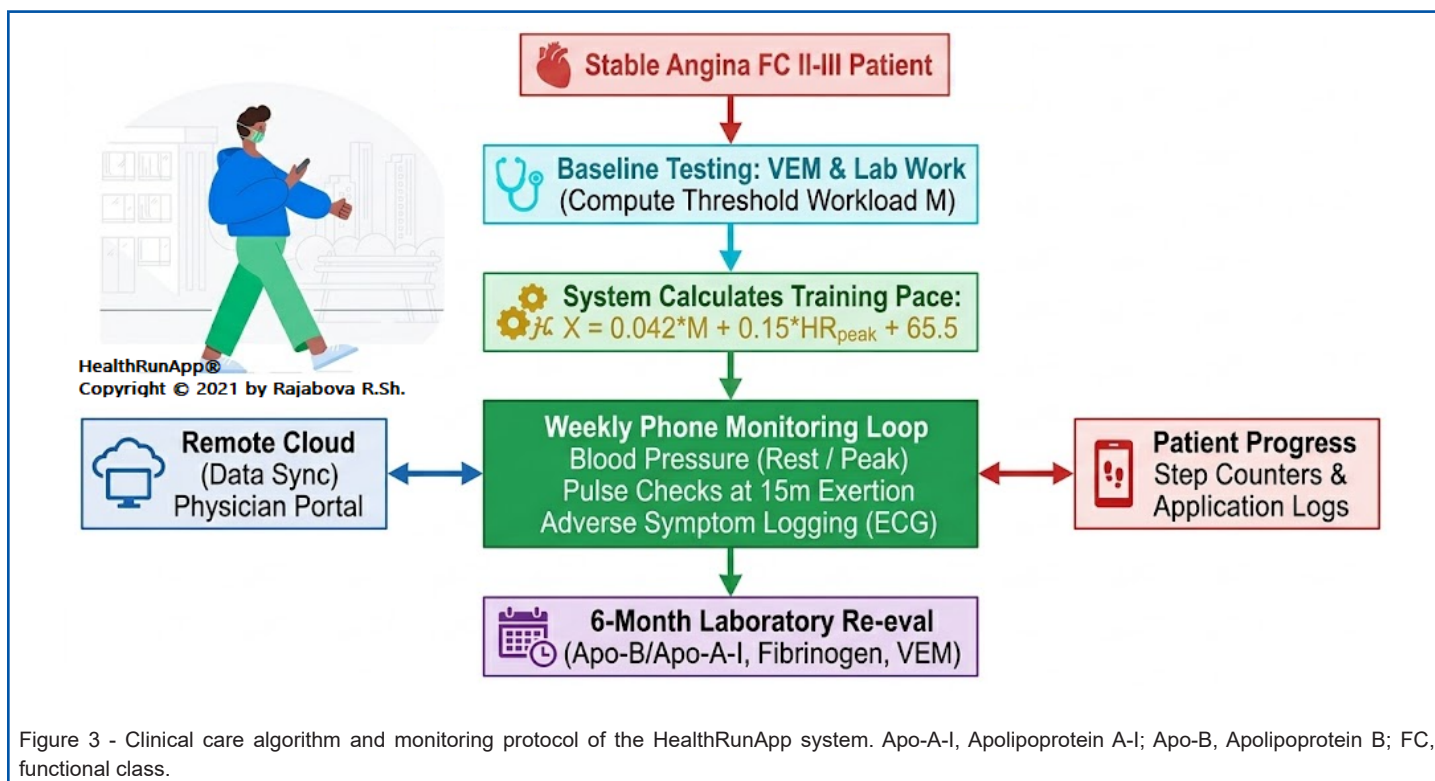
Biochemical markers also showed significant improvements [6]. Anti-atherogenic Apolipoprotein A-I (Apo-A-I) increased (108.3 ± 5.1 to 110.4 ± 4.2 mg/dL in urban; 109.2 ± 6.2 to 113.4 ± 5.1 mg/dL in rural; $p < 0.05$), while pro-atherogenic Apolipoprotein B (Apo-B) decreased (140.6 ± 8.4 to 129.6 ± 6.3 mg/dL in urban; 137.6 ± 9.1 to 126.4 ± 7.2 mg/dL in rural; $p < 0.05$) [6,33]. This led to a substantial reduction in the prognostic Apo-B/Apo-A-I ratio ($p < 0.001$), as

shown in Figure 2 [6,33]. Plasma fibrinogen was also reduced 1.3x (3.9 ± 0.05 to 3.1 ± 0.04 g/L in urban; 4.1 ± 0.09 to 3.0 ± 0.06 g/L in rural; $p < 0.001$) [6,33].

Discussion

The clinical results of this study highlight alarming trends in daily inactivity across this Central Asian cohort. The baseline finding that urban men spent 11.4 ± 1.8 hr per day sleeping indicates systemic hypersomnolence. Prolonged bed rest drastically reduces daily metabolic expenditure, accelerating myocardial deconditioning [12]. Additionally, screen time emerged as a major sedentary habit, with rural women averaging 5.7 ± 0.7 hr of television viewing daily. The gender-based difference in rural physical activity (3.4 ± 0.5 hr for men vs. 1.5 ± 0.4 hr for women) reflects traditional sociocultural roles in agricultural settings, while urban mechanisation tended to homogenise these patterns. Post-prandial sedentary behaviours further limit recovery; urban patients' reliance on seated activities like grandparenting tether elderly patients indoors, displacing structured aerobic exercise [24–26,28].

A key baseline finding was the profound cognitive dissonance between a patient's self-perceived health status and their actual, objective physiological limits [27,29]. The systemic overestimation of physical activity in subjective questionnaires (like ODA-23+) highlights the risk associated with relying solely on self-reports for clinical triaging [3,5,12,29]. The initial inability of approximately 80% of urban patients to sustain a pedal workload greater than 300–450 kg-m/min indicates a severe oxygen supply-demand mismatch [4].



However, the mHealth-guided 'HealthRunApp' intervention successfully reversed these trends, demonstrating the efficacy of structured mobile home-based reconditioning [30–32]. Tailoring exercise regimens based on individual functional classes improved both adherence and safety. Continuous, dosed aerobic walking significantly increased TWV across all demographics (up to 1.9-fold in rural women).

Crucially, follow-up cycle ergometry at 6 months demonstrated clear cardiovascular protection: the duration of tolerated exertion safely tolerated significantly increased ($p < 0.001$), while pathological ischaemic markers – specifically ST-segment shifts, supraventricular extrasystoles and ventricular extrasystoles – decreased dramatically. This anti-arrhythmogenic effect is likely driven by restored autonomic tone and increased vagal modulation, reducing myocardial electrical instability. Additionally, the intervention facilitated a favorable reduction in peak blood pressures under mechanical load, helping to manage hypertension in this population [1].

Given the socio-environmental factors and homebound status of this aging population, mHealth platforms coupled with remote clinical monitoring are highly effective for overcoming traditional barriers to cardiac rehabilitation in both urban and rural settings. The unified clinical algorithm designed to govern daily patient care is detailed in Figure 3 [15–23].

Conclusion

It is essential to actively combat hypodynamia in all patients with stable coronary syndromes, whether they reside in rural or urban areas [14,34]. The initial cognitive dissonance observed in this

cohort – where patients overestimated their physical capabilities – shows that self-reported clinical surveys are insufficient for accurate risk stratification [19,29]. Objective modalities, such as cycle ergometry, are necessary to establish safe, prior individualised training programs.

Ultimately, passive medical advice should be replaced with actively monitored, objectively quantified and culturally tailored cardiovascular rehabilitation programs. The integration of personalised mHealth tools, such as the 'HealthRunApp,' shows significant clinical efficacy, safely improving exercise tolerance, extending exertion duration and reducing ischaemic events and pathological arrhythmias in high-risk IHD patients [30–32].

Ethical approval

The study was conducted in strict accordance with the ethical principles of the Declaration of Helsinki. The study protocol was formally reviewed and approved by the Institutional Ethics Committee of Tashkent State Medical University (Protocol No. 4, dated 12 November 2019), and registered under the state academic registry B2020.4.PhD/Tib1510 [11].

Informed consent

Written, fully informed consent was obtained from all individual participants included in the study prior to enrollment and data collection. To ensure patient understanding and autonomy, all consent protocols, study explanations and documentation were

provided in the patients' primary communicative languages (Uzbek and/or Russian). All participants formally consented to the continuous monitoring of their physical activity and the use of their de-identified clinical, hemodynamic and psychometric data for international scientific publication.

Authors' contribution

- **SV:** Conceptualisation (lead); Methodology (lead); Investigation (lead); Formal analysis (lead); Project administration (lead); Writing – original draft (lead); Writing – review and editing (equal).
- **RSR:** Conceptualisation (equal); Methodology (equal); Supervision (lead); Validation (lead); Writing – review and editing (equal).
- **S:** Validation (supporting); Writing – review and editing (supporting); Reference verification.
- **SD:** Writing – review and editing (supporting); Reference verification.

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Adherence to ICMJE guidelines (AI disclosure)

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Appendices

Appendix 1: 'ODA-23+' physical activity Questionnaire with point-based scoring system

This specialized clinical instrument is translated and adapted from the original Uzbek Cyrillic clinical trial protocols to evaluate subjective daily and structured physical activity levels in patients with stable coronary heart disease [5].

No	Question	Alternative answer options	Points
1	If you are currently working, what is the level of physical activity required by your job?	1. My work is primarily sedentary. 2. My work involves extensive walking, but I do not lift heavy objects. 3. My work requires extensive walking and lifting heavy weights.	1.4 4.1 5.8
2	Do you regularly experience psycho-emotional stress either at work or at home?	1. Yes. 2. No.	3.0 1.7
3	How physically active are you during your leisure time or throughout a typical day?	1. I generally do not perform activities requiring physical effort. 2. I walk in the fresh air and perform chores requiring little physical effort. 3. I maintain a very active lifestyle, engage in physical exercise, and do not limit my physical exertion.	0.9 3.5 5.7
4	How many times per week do you spend your leisure time actively as described above?	State the exact number of times: _____	—
5	How many minutes do you walk in a typical day?	1. Less than 15 min. 2. 15–30 min. 3. 30–60 min. 4. More than 1 hr per day.	1.1 2.3 4.1 5.5
6	What is your typical walking pace/speed?	1. Fast. 2. Average. 3. Slow and leisurely.	5.7 3.8 1.3
7	What is the maximum distance you can walk continuously without needing to stop?	1. More than 1 km (indicate distance: ____ km). 2. Exactly 1 km. 3. 500–900 m. 4. 200–400 m. 5. Less than 200 m.	4.7 3.3 1.8 0.8 0.0
8	What is the primary clinical or physical reason that forces you to stop walking?	1. Retrosternal pain (chest pain behind the breastbone). 2. Discomfort in the region of the heart. 3. Shortness of breath (dyspnea). 4. Heart palpitations or cardiac arrhythmias. 5. Dizziness. 6. Pain or weakness in the lower extremities. 7. General fatigue (without specific pain/symptoms).	0.7 0.7 1.2 1.2 1.7 1.7 3.8
9	What is the absolute maximum distance you walk during an entire day?	1. Less than 1 km. 2. 1 km or more.	2.0 3.5
10	State the exact maximum daily walking distance in kilometers:	State value: _____ km	3.5 × km
11	How frequently do you utilize elevators instead of climbing stairs?	1. I always climb stairs and avoid elevators. 2. I always climb stairs, but not higher than the third floor. 3. There is no elevator in my house/work, so I must climb stairs (2+ floors) daily. 4. I rarely use the elevator because I live/work on the first or second floor. 5. Occasionally, if climbing only 1 or 2 floors, I walk. 6. I prefer to utilize the elevator in almost all situations.	5.8 4.7 4.9 2.6 2.5 1.2
12	How often do you perform physical activities that lead to slight dyspnea or sweating?	1. Daily. 2. 2–3 times per week. 3. Once per week. 4. 2–3 times per month. 5. Once per month or less. 6. I do not perform such physical activities.	5.3 4.5 3.4 2.3 1.6 0.2
13	How do you currently rate your overall physical condition and training capacity?	1. Very good. 2. Good. 3. Average. 4. Worse than average. 5. Poor.	5.6 4.9 3.7 1.7 0.7
14	Has your physical activity level changed over the past six months?	1. Significantly decreased. 2. Slightly decreased. 3. Remained exactly the same. 4. Increased.	0.8 2.3 3.5 5.2
15	Are you currently participating in structured physical exercise or training?	1. Yes (including recently started). 2. No.	5.3 0.8

No	Question	Alternative answer options	Points
16	Where have you primarily performed your physical exercise or training recently?	1. In an organized rehabilitation group at a medical facility.	5.4
		2. Individually at home.	4.2
17	What types of activities do your home training sessions include? (Select all that apply)	1. Gymnastic exercises.	3.1
		2. Structured walking.	4.2
		3. Running/Jogging.	5.1
		4. Outdoor cycling.	5.3
		5. Stationary cycling or mechanical trainers.	5.3
		6. Dumbbell exercises.	5.4
		7. Swimming.	5.4
18	How many times per week do you perform structured exercise?	8. Skiing.	5.5
		9. Active sports games (football, tennis, etc.).	5.5
		1. Less than once per week.	2.0
		2. 1–2 times per week.	3.8
19	What is the average duration of each exercise session in minutes?	3. 3–4 times per week.	2.0
		4. 5 times or more per week.	6.1
		1. Less than 20 min.	3.2
20	If you do not exercise, what is your primary reason? (Select one main reason)	2. 20–30 min.	4.7
		3. More than 30 min.	5.9
		1. I believe exercise is harmful to my current state of health.	0.4
		2. I believe exercise does not provide any benefit.	0.7
		3. I already lead an active lifestyle and do not need extra exercise.	4.0
		4. I do not consider it necessary.	1.3
		5. I cannot motivate/force myself to start exercising.	1.6
		6. I would only exercise if it were organized in a medical facility.	2.5
21	What is your current frequency of sexual activity?	7. My current state of health prevents me from exercising.	0.8
		8. Structured exercise is medically forbidden/contraindicated.	1.5
		1. More than once per week.	5.3
		2. 2–4 times per month.	4.1
22	How much time do you spend inside a car daily as either a driver or a passenger?	3. Once per month or less.	2.1
		4. Very rarely or none.	0.5
		1. 3 hr or more per day.	1.6
		2. 2–3 hr per day.	2.3
23	What household chores do you regularly perform? (e.g., shopping, cooking, cleaning, etc.)	3. 1–2 hr per day.	3.0
		4. Less than 1 hr per day, or not every day.	3.8
		1. I perform household chores for more than 1 hr every day.	5.2
		2. I do chores under 1 hr daily, but spend 1+ hr on weekends.	4.5
		3. I do chores daily or almost daily, but for under 1 hr per day.	3.8
		4. I do not do much housework, but must perform heavy chores.	3.7
		5. I perform housework only occasionally.	2.0
		6. I do not perform any household chores.	0.8

Appendix 2: SF-36 quality of life survey (Uzbek trial translation & scoring keys)

This is the localized translation of the SF-36 Health Survey used during the clinical evaluation of the prospective cohort.

Section I: General health self-assessment

How would you rate your health in general? (Select one option):

- Excellent 1
- Very Good 2
- Good 3
- Fair/Average 4
- Poor 5

Section II: Health changes over time

Compared to 1 year ago, how would you rate your health in general now? (Select one option):

- Much better now than 1 year ago 1
- Somewhat better now than 1 year ago 2
- About the same as 1 year ago 3
- Somewhat worse now than 1 year ago 4
- Much worse now than 1 year ago 5

Section III: Physical limitations

No	Does your health now limit you in these activities? If so, how much?	Scoring options		
		Yes, limited a lot	Yes, limited a little	No, not limited at all
A.	Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.	1	2	3
B.	Moderate activities, such as moving a table, vacuuming, dusting, or gathering berries.	1	2	3
C.	Lifting or carrying groceries.	1	2	3
D.	Climbing several flights of stairs.	1	2	3
E.	Climbing one flight of stairs.	1	2	3
F.	Bending, kneeling, or stooping.	1	2	3
G.	Walking more than 1 km.	1	2	3
H.	Walking several blocks.	1	2	3
I.	Walking one block.	1	2	3
J.	Bathing or dressing yourself.	1	2	3

Section IV: Role limitations due to physical health

No	During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?	Scoring options	
		Yes	No
A.	Cut down on the amount of time you spent on work or other activities.	1	2
B.	Accomplished less than you would like.	1	2
C.	Were limited in the kind of work or other activities.	1	2
D.	Had difficulty performing the work or other activities (e.g., it took extra effort).	1	2

Section V: Role limitations due to emotional problems

No	During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?	Scoring options	
		Yes	No
A.	Cut down on the amount of time you spent on work or other activities.	1	2
B.	Accomplished less than you would like.	1	2
C.	Did not do work or other activities as carefully as usual.	1	2

Section VI: Social functioning & bodily pain.

(Scoring scale for Question 1 & 3: 1 = Not at all | 2 = Slightly | 3 = Moderately | 4 = Quite a bit/Strongly | 5 = Extremely/Very)

- During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups? (1 / 2 / 3 / 4 / 5)
- How much bodily pain have you had during the past 4 weeks?:
 - None 1
 - Very mild 2
 - Mild 3
 - Moderate 4
 - Severe/Strong 5
 - Very severe 6
- During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)? (1 / 2 / 3 / 4 / 5)

Section VII: Emotional well-being & vitality

No	These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling	Scoring options					
		<i>All of the time</i>	<i>Most of the time</i>	<i>A good bit of the time</i>	<i>Some of the time</i>	<i>A little bit of the time</i>	<i>None of the time</i>
A.	Did you feel full of life/pep?	1	2	3	4	5	6
B.	Have you been a very nervous person?	1	2	3	4	5	6
C.	Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
D.	Have you felt calm and peaceful?	1	2	3	4	5	6
E.	Did you have a lot of energy?	1	2	3	4	5	6
F.	Have you felt downhearted and blue?	1	2	3	4	5	6
G.	Did you feel worn out?	1	2	3	4	5	6
H.	Have you been a happy person?	1	2	3	4	5	6
I.	Did you feel tired?	1	2	3	4	5	6

Section VIII: Social interference frequency

During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?:

- All of the time 1
- Most of the time 2
- Some of the time 3
- Rarely 4
- None of the time 5

Section IX: General health perceptions

No	How TRUE or FALSE is each of the following statements for you?	Scoring options				
		<i>Definitely true</i>	<i>Mostly true</i>	<i>Don't know</i>	<i>Mostly false</i>	<i>Definitely false</i>
A.	I seem to get sick a little easier than other people.	1	2	3	4	5
B.	I am as healthy as anybody I know.	1	2	3	4	5
C.	I expect my health to get worse.	1	2	3	4	5
D.	My health is excellent.	1	2	3	4	5