Rehabilitation for Cardiovascular Disease: Updates and Opportunities

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Disclosures

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“I had thrust upon me the unpleasant fact that I was indeed a sick man.“

All of the 42 patients in this group were ambulatory and able to come to the hospital for examination. Eighteen were carrying on their customary full duty. Four were estimated to be doing 75%, and nine were performing 50% of their previous activities. Seven were either unable or unwilling to do any work, and the remaining four were retired before the initial attack and had not resumed work. The occupations of most of this group of 42 were sedentary.

DEVELOPMENT OF ANEURYSMS

Postmortem examination provides the most reliable evidence of the presence of a ventricular aneurysm. The pathological reports indicate that anywhere from 5% to 38% of all myocardial infarctions are followed by aneurysm formation in the injured ventricle. Yater reports an incidence of 20% of men over the age of 40.[2] Clinical

TABLE 1.—*Follow-Up Study of Seventy-Three Armchair-Treated Patients with Acute Myocardial Infarction**

	Patients Who Died	Living Patients Reexamined	Living Patients Not Reexamined
Average survival period.....	11 mo.	26 mo.	29 mo.

Outline of Graded Activity Program

ACTIVITY LEVEL 1
Self Care in Bed

A. Wash face and brush teeth
B. Eat breakfast
C. Move with assistance (not lifted) from bed onto bedside commode and return

ACTIVITY LEVEL 2
Active Exercises in Bed
(Directed by Physical Therapist—10 Repetitions of Each Exercise)

A. Breathe deeply (patient in supine position)
B. Move shoulders through all ranges of motion
   1. Flex and extend the arm
   2. Abduct and adduct the arm
C. Raise straightened leg—5 repetitions each side
D. Flex trunk to raise shoulders and chest from bed—with arms folded across the chest

ACTIVITY LEVEL 3
Active Exercise in Bed
(Ten Repetitions of Each Exercise)

A. Lie on side—abduct thigh with legs straight
B. Lie in prone position (5 repetitions each extremity)
   1. Extend thigh with leg straight
   2. Flex leg
C. Sit on edge of bed
   1. Move shoulders through all ranges of motion
   2. Abduct arms—bring hands directly over head
   3. Extend each leg 5 times

ACTIVITY LEVEL 4
Self Care and Level Walking

A. Sit on side of bed for sponge bath
B. Put on robe and slippers
C. Walk on level 35 ft. forward and return

Following successful completion of this Activity Level patients receive bathroom privileges

ACTIVITY LEVEL 5
Self Care and Level Walking

A. Sit on side of bed for sponge bath
B. Put on trousers and slippers
C. Walk on level 100 ft. forward and return

ACTIVITY LEVEL 6

Repeat Activity Level 5

ACTIVITY LEVEL 7
Walking on Incline

A. Walk down and up hospital ramp (10% grade, 48 ft. long)
B. Walk 5 single trips across Master Steps

Following successful completion of this activity level, patients are allowed to leave their room when desired.

ACTIVITY LEVEL 8
Light Work Tolerance
(Directed by Occupational Therapist)

A. Walk down hospital ramp to clinic area—sit and rest
B. Spend one hour in occupational therapy area doing handcrafts and learning energy saving methods
C. Sit and rest—then walk up hospital ramp to room

ACTIVITY LEVEL 9

Repeat Activity Level 8

ACTIVITY LEVEL 10
Self Care and Stair Climbing

A. Groom
B. Take tub bath
C. Walk up and down flight of stairs (18 6-in. steps with halfway landing)

by 20 beats per minute—with or without irregularity of rhythm after activity—was the most reliable physical sign of possible underlying coronary insufficiency; yet it occurred in only 44 per cent (73 out of 166) of electrocardiographically substantiated cases. This increase in the pulse rate was assumed to be related to poor physical condition in the "pass" group. Fatigue or dyspnea were present in only 13.9 per cent (23 out of 166) and angina in 12.0 per cent (20 out of 166) of proved cases of coronary insufficiency. All patients who had a "fail" performance showed evidence of significant

Cain HD *et al*, *JAMA* 1961;177:111-5.

tensive care units would probably never be available to all who could possibly use them. Hospital facilities with intensive care units are now readily available and their use is routine for hospitalized patients by about 67%, 87%, and 89% of general practitioners, internists, and cardiologists, respectively.

There has been a reduction in the period of bed rest,[2] of hospitalization, and of convalescence after myocardial infarction, and less delay in return to work. A median hospital stay of 21 days and a median return to

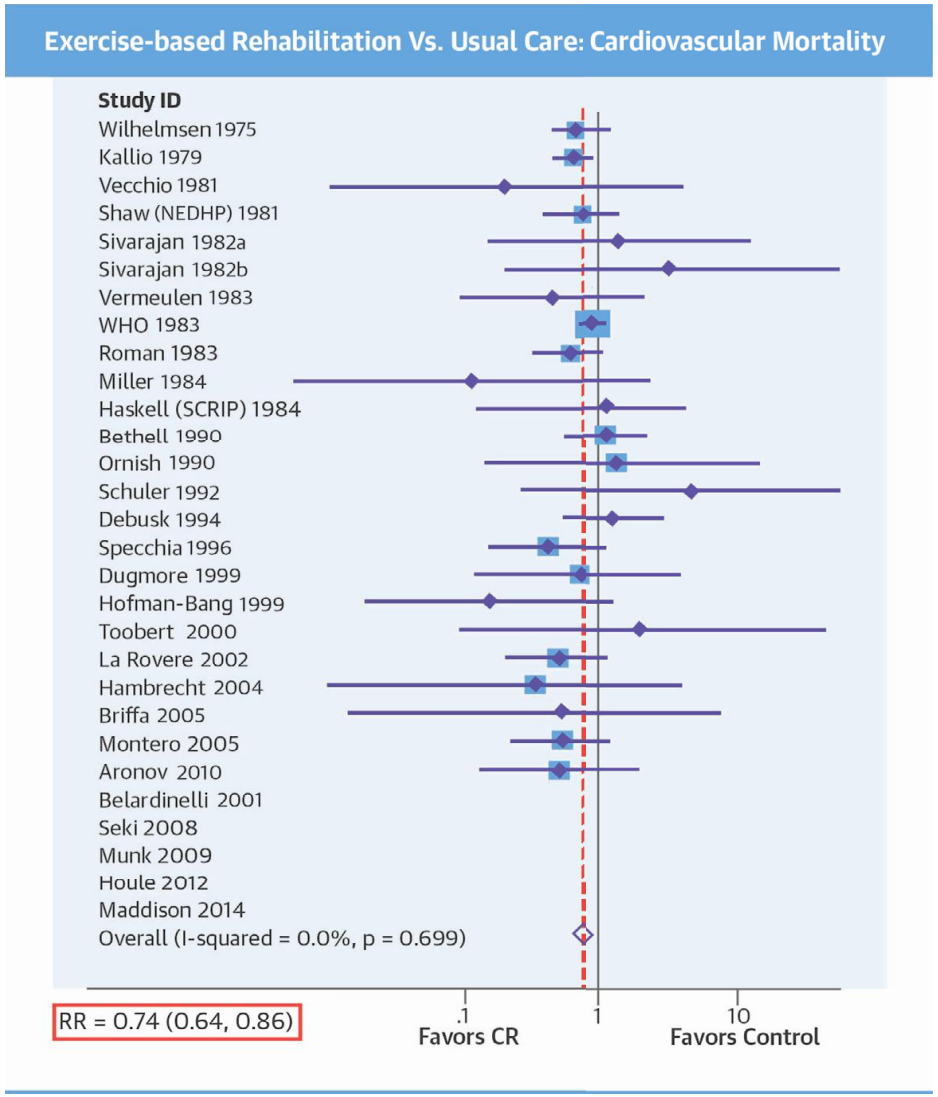
fat- and sodium-restricted diets in 1970.

This survey identifies unmet needs to improve the management of and the outlook for patients with myocardial infarction. There is a need to make available more intensive care units and progressive care units, especially for use by nonmetropolitan area general practitioners. Educational programs for general practitioners should emphasize that available intensive care facilities should be used routinely, not just for "selected" myocardial infarction patients.[8]

Table 3.—Use of St

	P
Use of standard exercise tests, %	
Reasons for not using standard exercise tests,* % of nonusers	
Do not consider more helpful than clinical evaluation	
Concern for patient safety	
Unfamiliarity with tests	
Lack of equipment	

CENTRAL ILLUSTRATION **Exercise-Based Cardiac Rehabilitation for Coronary Heart Disease Versus Usual Care: CV Mortality and Hospitalization**

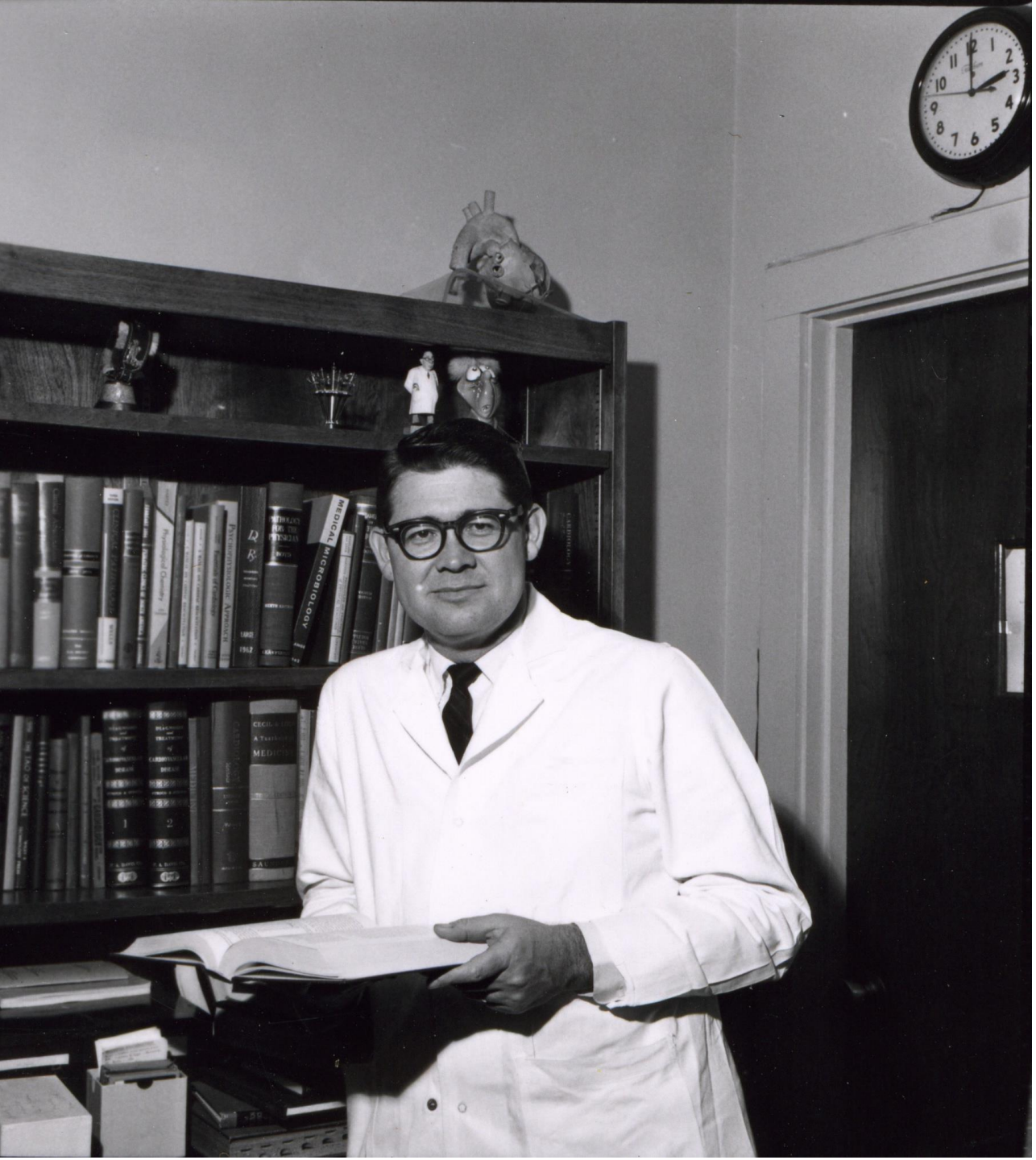


Anderson, L. et al. J Am Coll Cardiol. 2016; 67(1):1-12.

Box sizes are proportional to the weight of each study in the analysis, and the **lines** represent their 95% confidence intervals (CIs). The **open diamond** represents the pooled RR, and its width represents its 95% CI. CV = cardiovascular.

Indications for Cardiac Rehabilitation:

- Acute MI within the preceding 12 months
- CABG
- Stable angina pectoris
- Heart valve repair/replacement
- Percutaneous coronary intervention
- Heart or heart-lung transplant
- Chronic heart failure
- Peripheral arterial disease



treatment. Nearly all patients fed themselves and were either permitted the use of the bedside commode or were granted toilet privileges....

The observation made by Levine and Lown a quarter of a century ago has influenced the care of patients with acute myocardial infarction ever since.

Common sense dictates that patient management should be individualized. Anyone who says he individualizes the management of patients should be able to enumerate the variable that he uses to make his decisions. Four major variables must be considered to individualize the amount of activity a patient with acute myocardial infarction is permitted: the emotional and physical status of

Hurst, JW *NEJM*;1975;292:746-8

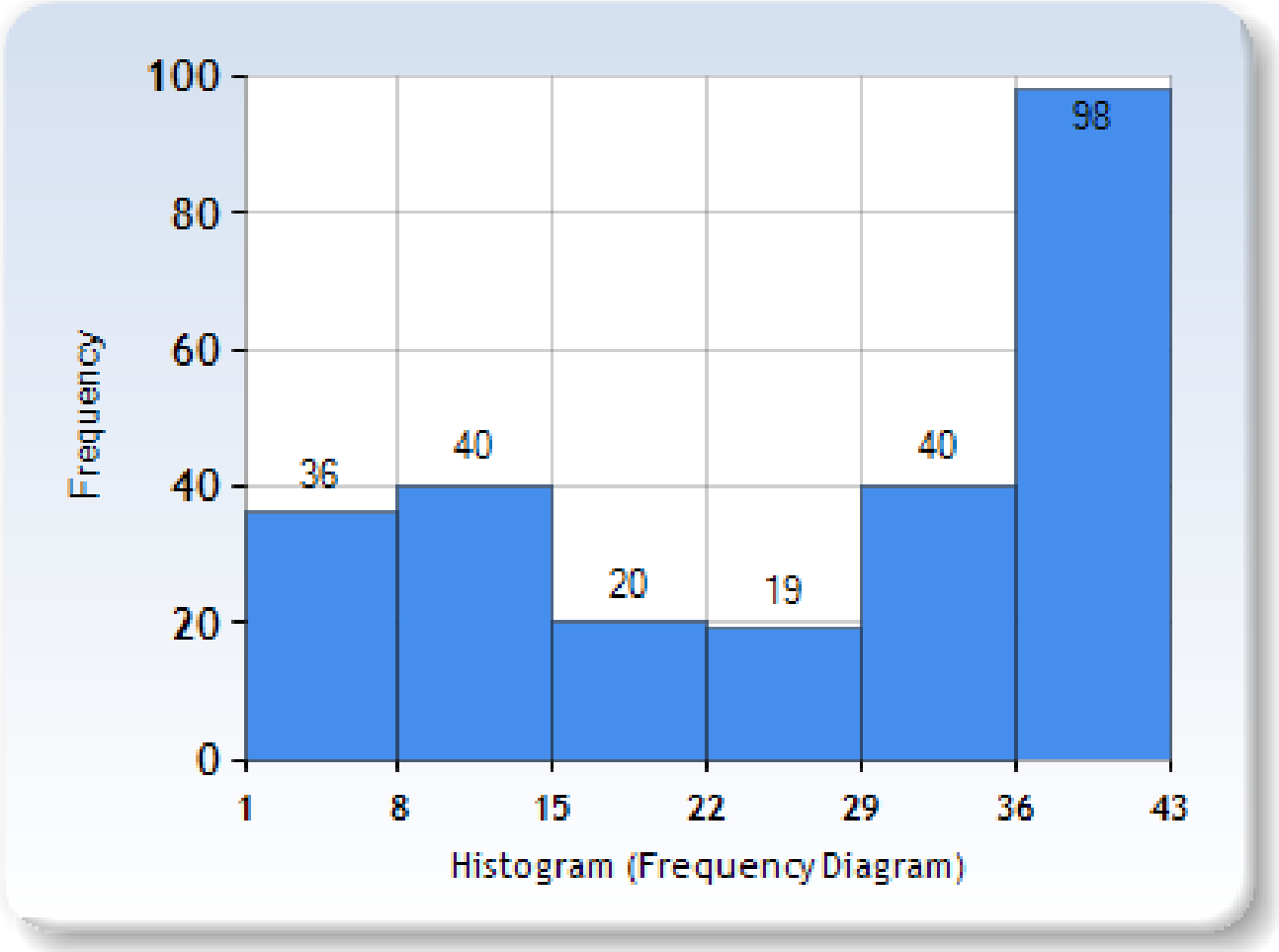
Cardiac Rehab Checklist

- ❑Medications
- ❑Nutrition
- ❑Weight
- ❑Blood Pressure
- ❑Lipids
- ❑Diabetes
- ❑Tobacco
- ❑Psycho-social Evaluation
- ❑Physical Activity

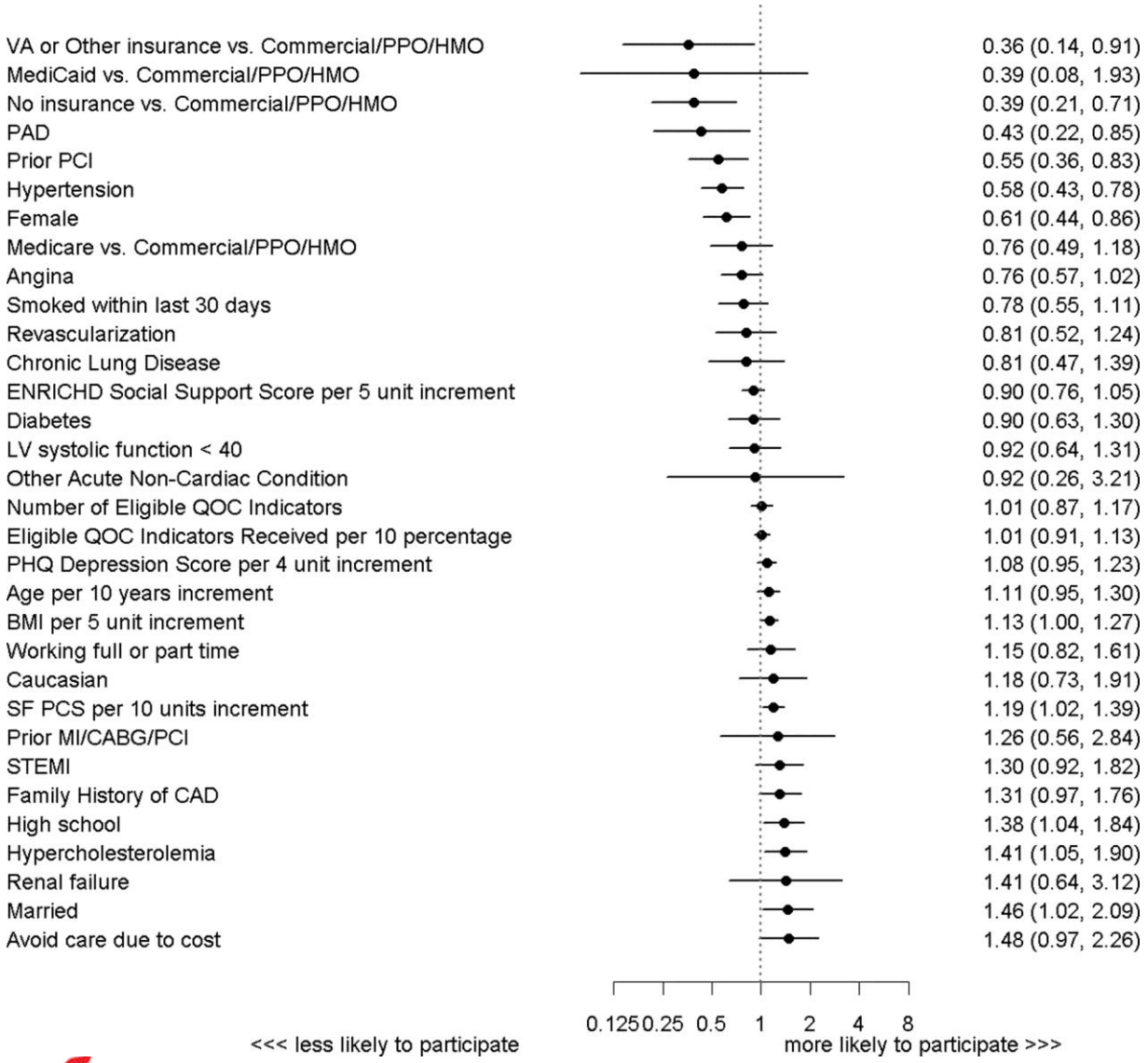
• Develop an **individualized exercise prescription** for aerobic and resistance training that is based on evaluation findings, risk stratification, comorbidities (e.g., peripheral arterial disease and musculoskeletal conditions), and patient and program goals. The exercise regimen should be reviewed by the program medical director or referring physician, modified if necessary, and approved. Exercise prescription should specify frequency (F), intensity (I), duration (D), modalities (M), and progression (P).
• For **aerobic** exercise: F=3-5 days/wk; I=50-80% of exercise capacity; D=20-60 minutes; and M=walking, treadmill, cycling, rowing, stair climbing, arm/leg ergometry, and others using continuous or interval training as appropriate.
• For **resistance** exercise: F=2-3 days/wk; I=10-15 repetitions per set to moderate fatigue; D=1-3 sets of 8-10 different upper and lower body exercises; and M=calisthenics, elastic bands, cuff/hand weights, dumbbells, free weights, wall pulleys, or weight machines.
• Include warm-up, cool-down, and flexibility exercises in each exercise session.
• Provide progressive updates to the exercise prescription and modify further if clinical status changes.

Circulation. 2007;115:2675-2682

Cardiac Rehab Completion at Piedmont Athens Regional 2016-2017



Multivariable prediction model for participation in cardiac rehabilitation at 1 month after acute myocardial infarction.



"Only 29% (419/1450) and 48.25% (650/1347) of AMI patients who received referral for CR participated within 1 and 6 months after discharge, respectively."

Susmita Parashar et al. Circulation. 2012;126:1587-1595

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Efficacy and Safety of Exercise Training in Patients With Chronic Heart Failure: HF-ACTION Randomized Controlled Trial

Table 1. Baseline Characteristics

Characteristics	No. (%) of Patients[a]	
	Usual Care (n = 1172)	Exercise Training (n = 1159)
Age, median (IQR), y	59.3 (51.1-68.2)	59.2 (51.2-67.8)
Female sex	314 (26.8)	347 (29.9)
Hispanic or Latino ethnicity[b]	48/1162 (4.1)	40/1147 (3.5)
Race[b]		
Black or African American	372/1156 (32.2)	377/1140 (33.1)
White	728/1156 (63.0)	698/1140 (61.2)
Other	56/1156 (4.8)	65/1140 (5.7)
NYHA class		
II	754 (64.3)	723 (62.4)
III	409 (34.9)	422 (36.4)
IV	9 (0.8)	14 (1.2)
Ischemic etiology of heart failure	599 (51.1)	598 (51.6)
Left ventricular ejection fraction, median (IQR), %	24.9 (20.0-30.2)	24.6 (20.0-30.0)

Table 4. Change in 6-Minute Walk Test and Cardiopulmonary Exercise Test Results

	Median (IQR)		
	Usual Care	Exercise Training	*P* Value
Baseline to 3 mo[a]			
Distance of 6-minute walk, m (n = 1835)	5 (–28 to 37)	20 (–15 to 57)	<.001
Cardiopulmonary exercise time, min (n = 1914)	0.3 (–0.6 to 1.4)	1.5 (0.3 to 3.0)	<.001
Peak oxygen consumption, mL/kg/min (n = 1870)	0.2 (–1.2 to 1.4)	0.6 (–0.7 to 2.3)	<.001

JAMA. 2009;301(14):1439-1450. doi:10.1001/jama.2009.454

Date of download: 2/7/2016

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Rehab Improves Symptoms in Heart Failure

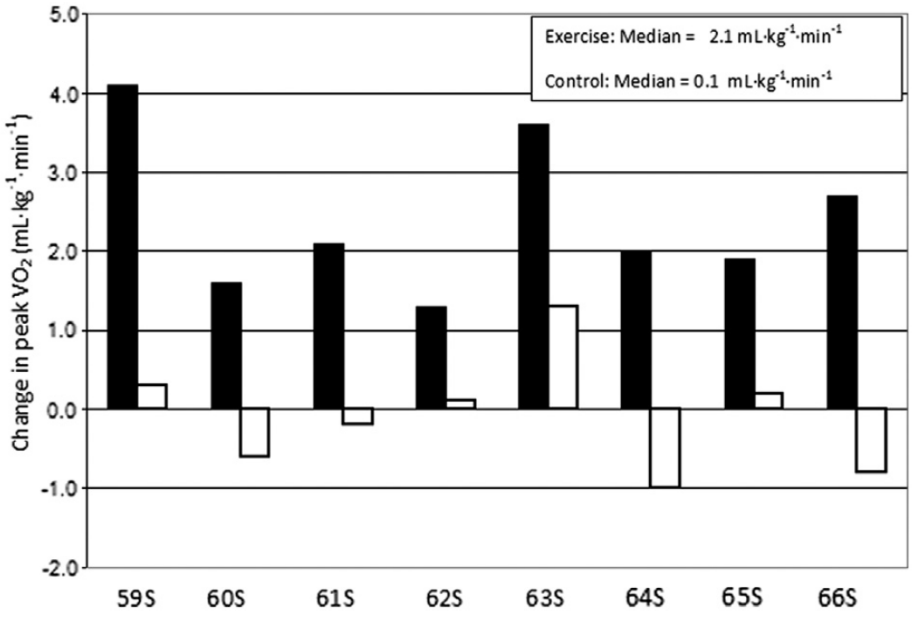


Figure 1 **Reported Changes in Peak Vo_2 in Aerobic Exercise-Trained Subjects**

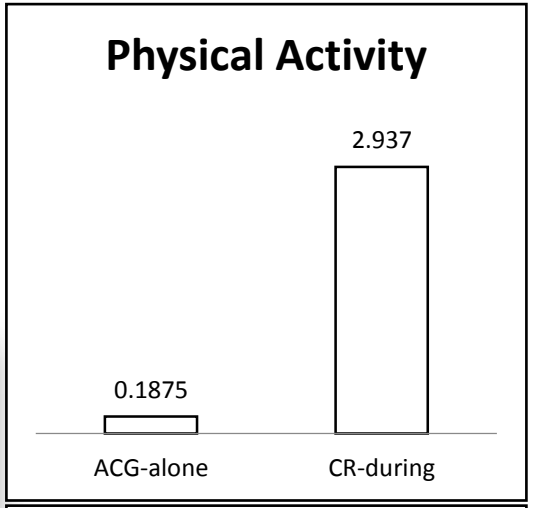
Subjects are from 8 single-site, randomized clinical trials in patients with congestive heart failure (13). **Solid bars** represent exercise-trained subjects; **open bars** represent control subjects. Vo_2 = oxygen uptake. Adapted, with permission, from Keteyian (13).

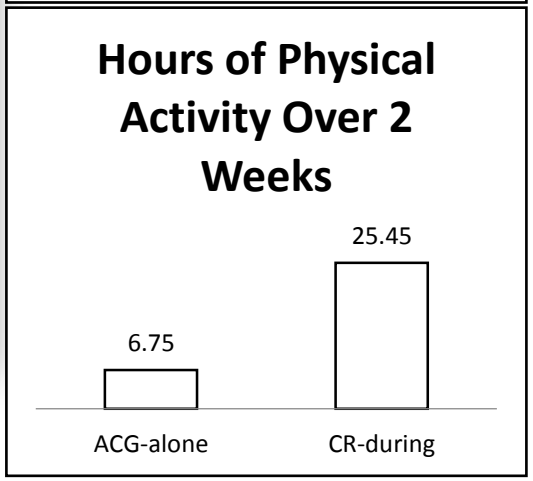
J Am Coll Cardiol HF 2013;1

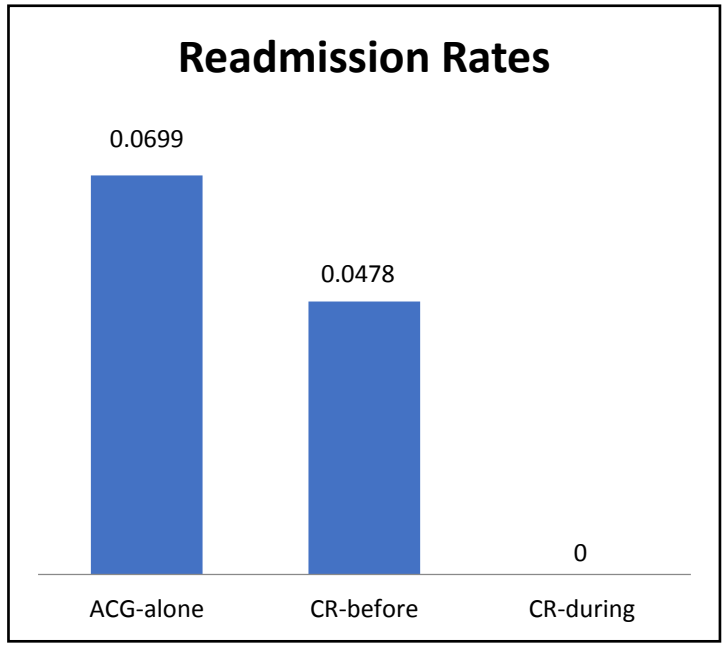
CARDIAC REHABILITATION AS A PREDICTOR FOR READMISSION IN HEART FAILURE PATIENTS

Hannah Childs[1], Jonathan Murrow, M.D.[2,3]
[1]Medical Scholars Program, Augusta University/University of Georgia Medical Partnership, Athens, GA;[2]Athens Cardiology Group, Athens, GA, [3]Augusta University/University of Georgia Medical Partnership, Athens, GA

- We conducted a chart review of 56 heart failure patients of Athens Cardiology Group (ACG) who have been admitted for heart-failure within the past year. Half of the patients were enrolled in Cardiac Rehab (CR).







Peripheral Arterial Disease

Intermittent Claudication, due to Chronic Arteritis Obliterans, in a Tobacconist.

By F. PARKES WEBER, M.D.

The Wesley M. Carpenter Lecture

MUSCULAR PAIN IN INTERMITTENT CLAUDICATION*

SIR THOMAS LEWIS
London

The term intermittent claudication seems first to have been used by Bouley in 1831 to describe a condition of lameness in the horse, developing after a short period of exercise, and caused by obliteration of the main vessels of the limb; his account was followed by that of other veterinarians. In 1846 Brodie and later Charcot noticed a similar condition in human patients suffering from senile arteritis or from aneurysm of the common iliac artery. Erb's collection of clinical and pathological observations led to wide recognition of the malady and served to establish that obstructive arterial disease is the usual anatomical defect and that lameness developing during exercise results usually from pain. It is with the origin of this pain that the present lecture deals.

Exercise in PAD

"Exercise programs are of significant benefit compared with placebo or usual care in improving walking time and distance in people with leg pain from intermittent claudication"

- 30 trials reviewed
- 1816 participants
- Walking time improved 50-200%
- No change in ABI

- Cochrane Database Syst Rev. 2014 Jul 18;(7)

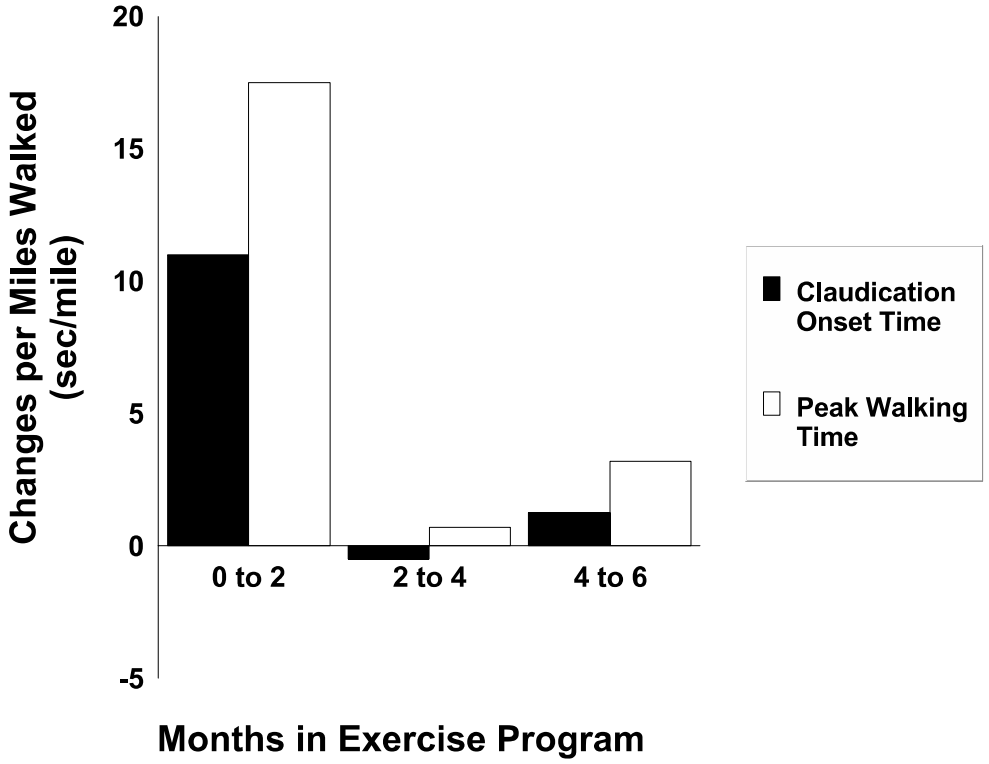
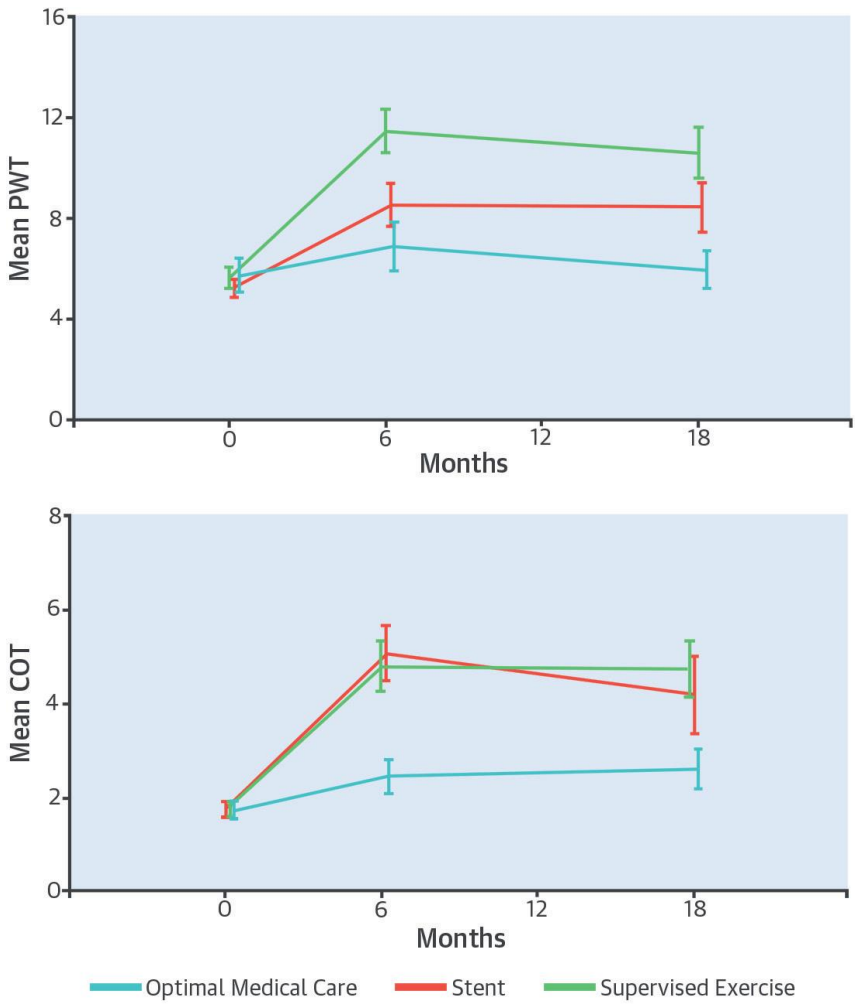


Fig 2. Changes in claudication onset time (COT) and peak walking time (PWT) per mile walked during different stages of an exercise rehabilitation program.

J Vasc Surg 2012;55:1346-54

CENTRAL ILLUSTRATION **Exercise or Intervention for Claudication Due to Aortoiliac PAD: PWT and COT**



Murphy, T.P. et al. J Am Coll Cardiol. 2015; 65(10):999–1009.

(Upper panel) PWT. Patients with 18-month follow-up visit only. **(Lower panel)** COT. COT = claudication onset time on a graded treadmill test; PAD = peripheral artery disease; PWT = peak walking time on a graded treadmill test.

FIGURE 1 **CONSORT Diagram**

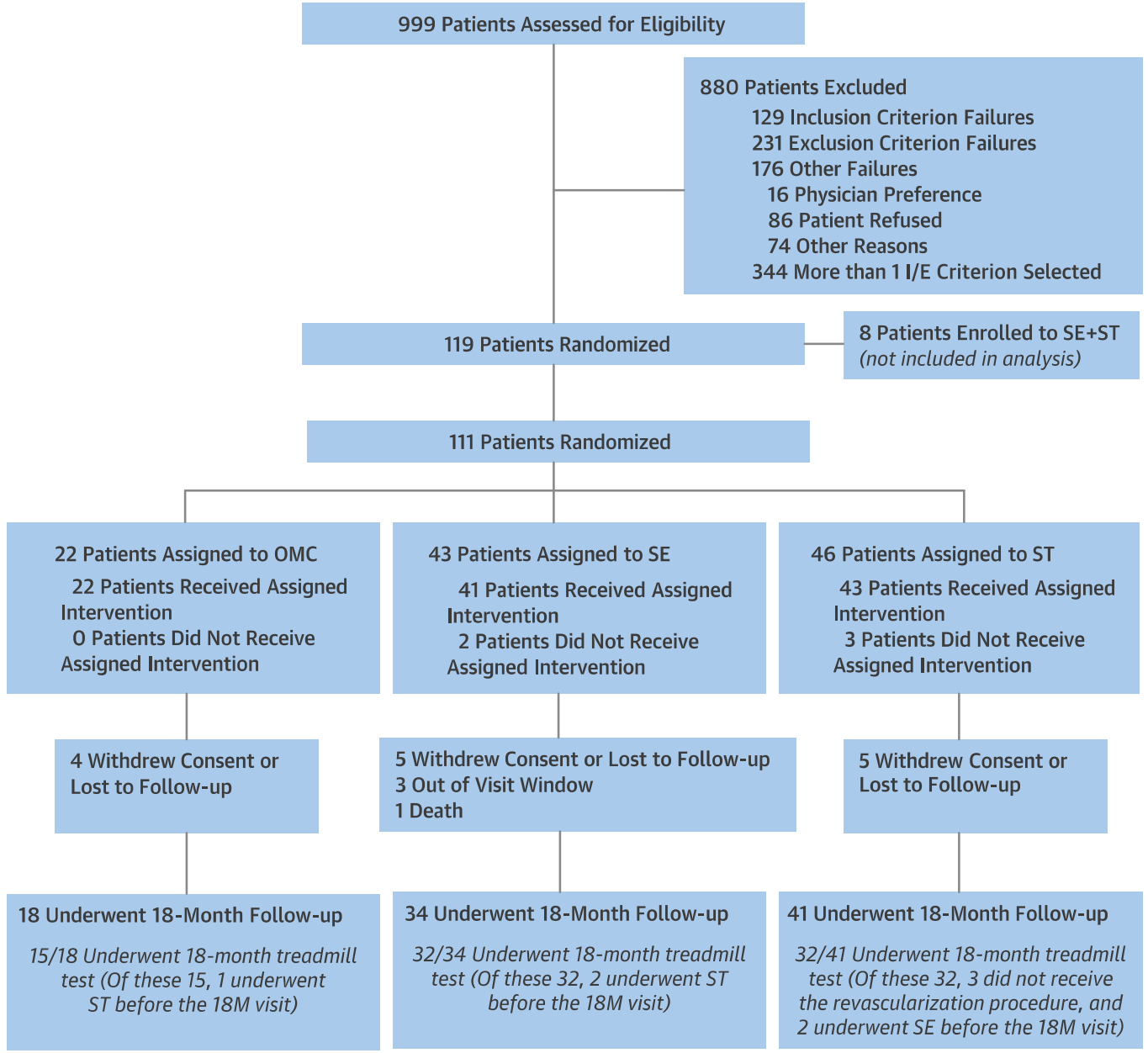


Table III. Summary of incomplete adherence according to reason for failure to complete SEP ranked by frequency of reporting

Rank	Reason for incomplete adherence	*n*	Percentage
1	Withdrew—lack of motivation	241	29.2
2	Comorbidities—health reason not related to SEP	191	23.1
3	Withdrew—patient choice	138	16.7
4	Withdrew—lack of results	67	8.2
5	Death	38	4.6
6	Travel problems	32	3.8
7	Noncontactable	25	3
8	Progression of PVD	24	2.9
9	Time or family/work commitments	23	2.8
10	Withdrew—felt ''cured''	23	2.8
11	SEP adverse event	9	1
12	Insurance	9	1
13	Withdrawn by research team for non adherence	4	0.5
	Total	824	100

Ann Vasc Surg. 2016 Jul;34:280-9

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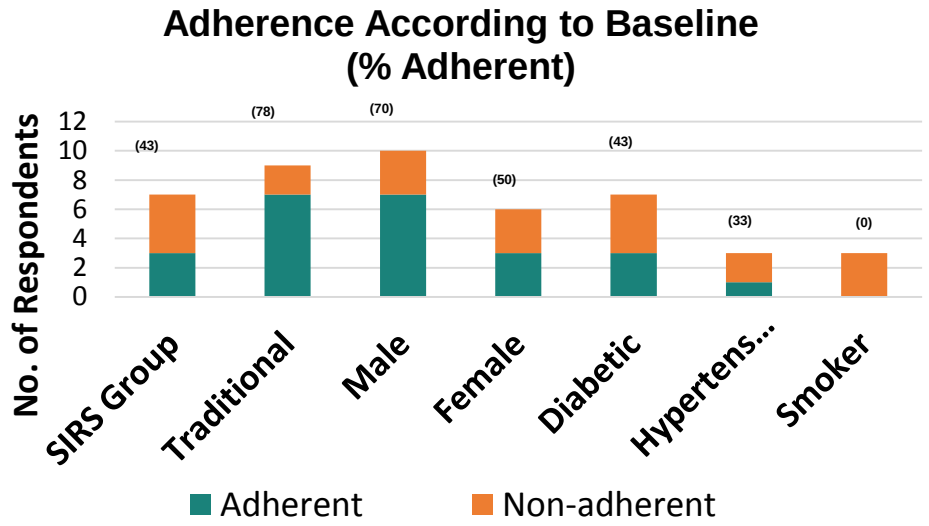
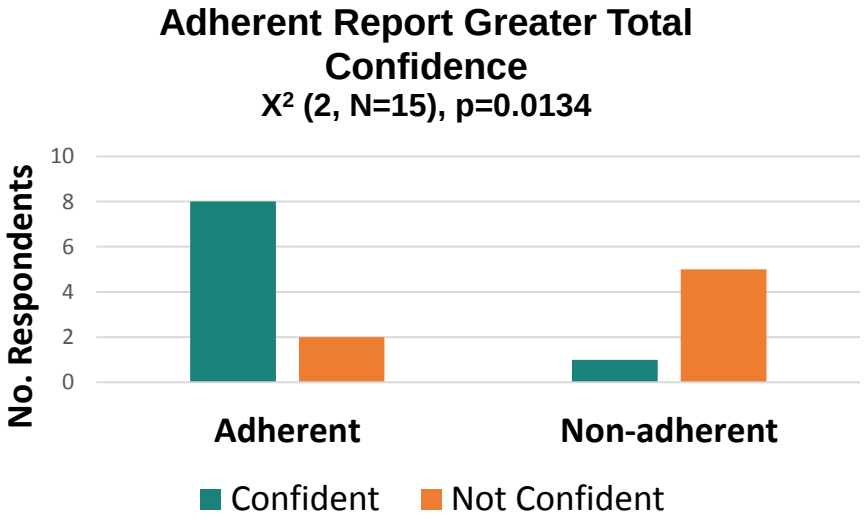
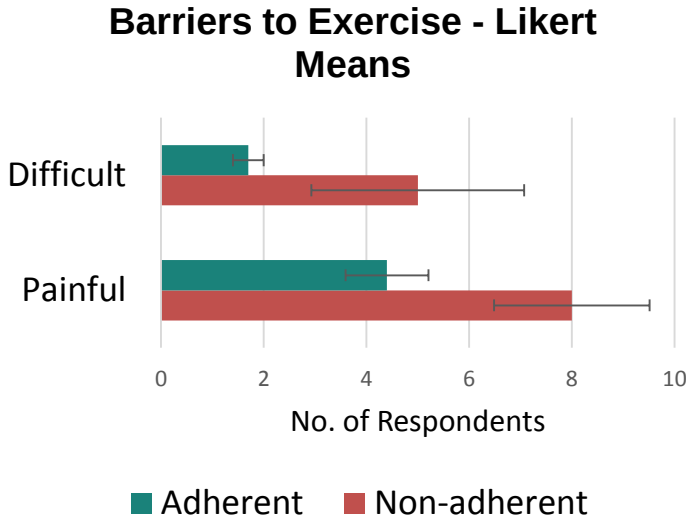
PAD PATIENT ADHERENCE TO SUPERVISED EXERCISE: WHAT ARE THE BARRIERS?

C. Allen Witt, Jared Brizendine, Jonathan R. Murrow, M.D., GRU/UGA Medical Partnership – Athens, GA

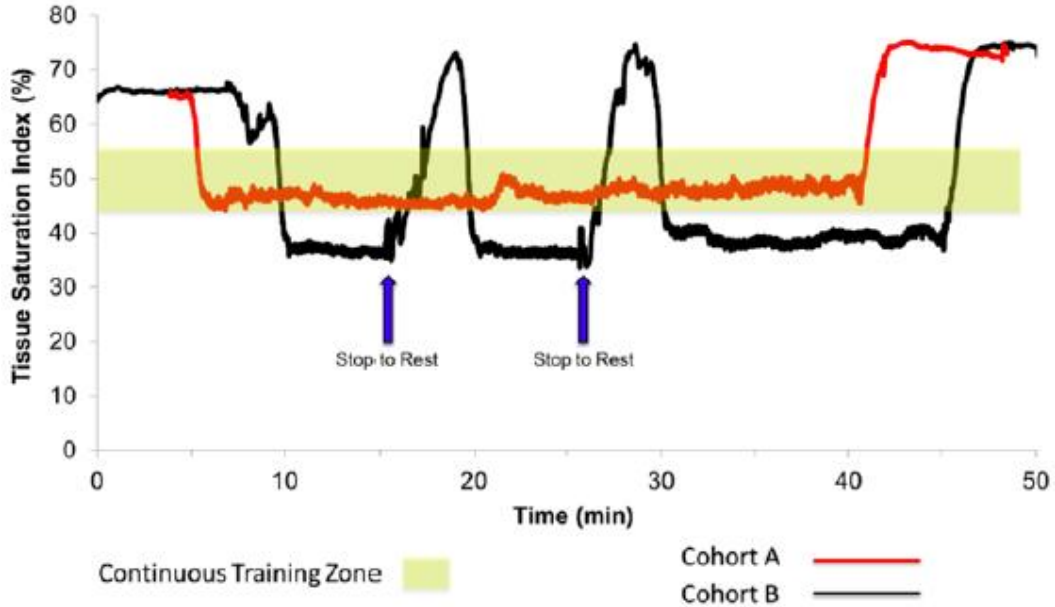
N=16	Mean (CI 95%)
Age	72 (5.50)
Body Mass Index	28 (2.74)
	n, (%)
Sex	
Male	10 (62.5)
Female	6 (37.5)
Overweight[a]	8 (50)
Obese[b]	4 (25)
Diabetes	7 (44)
Hypertension[c]	3 (19)
Current Smoker	3 (19)
Exercise Group	
NIRS	7 (44)
Traditional	9 (56)





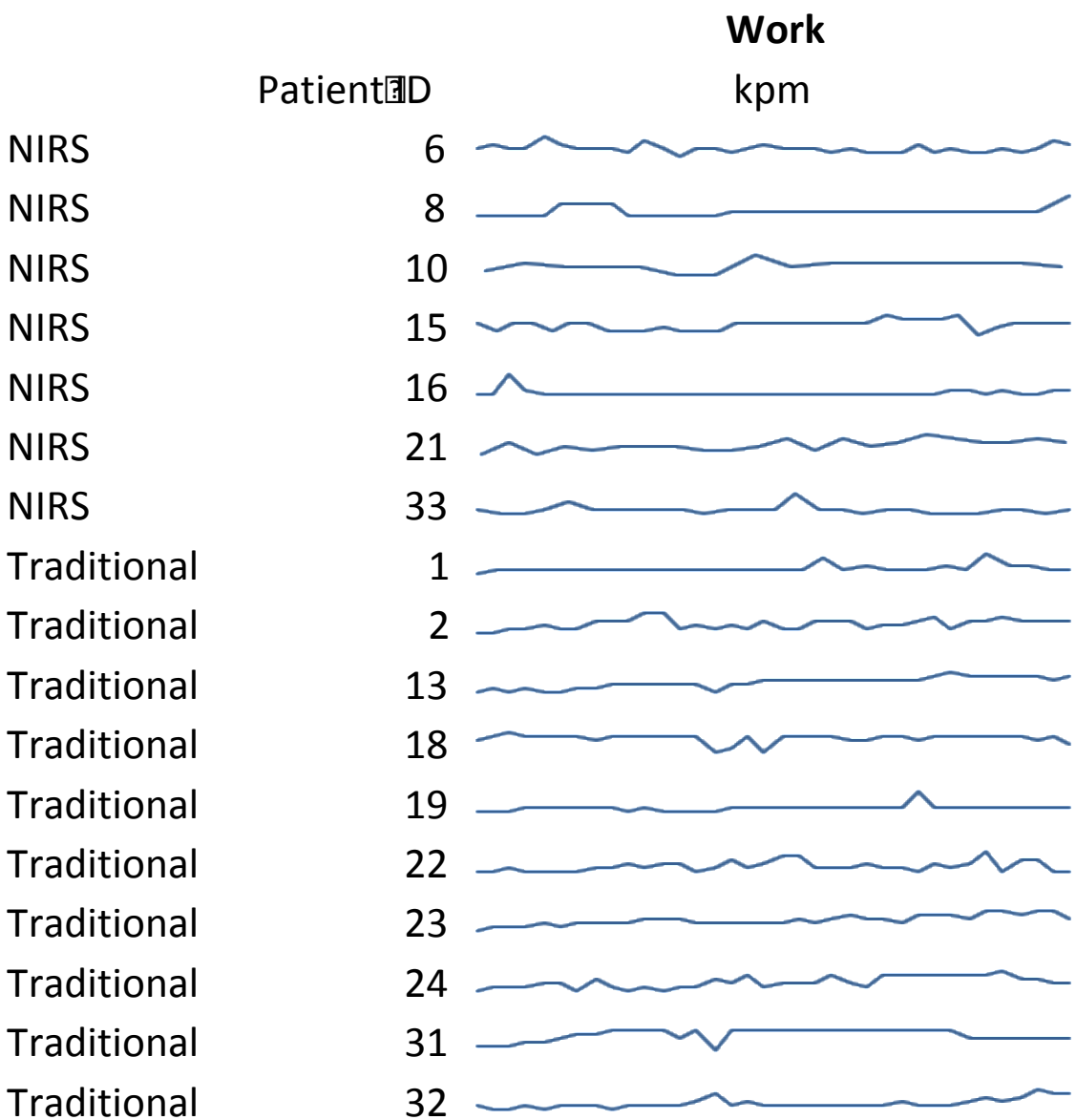


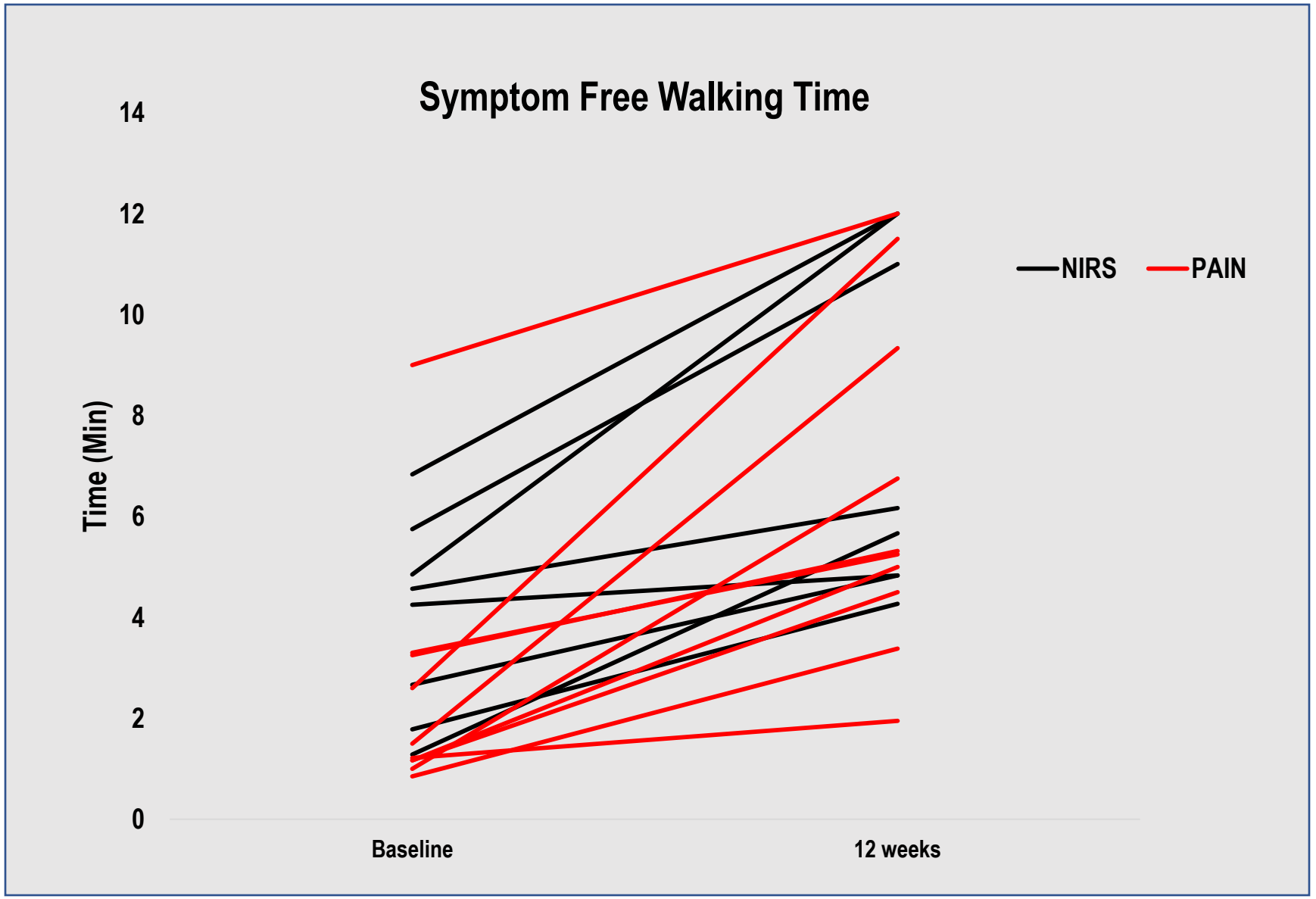
Using Near Infrared Spectroscopy Guided Training for Peripheral Arterial Disease

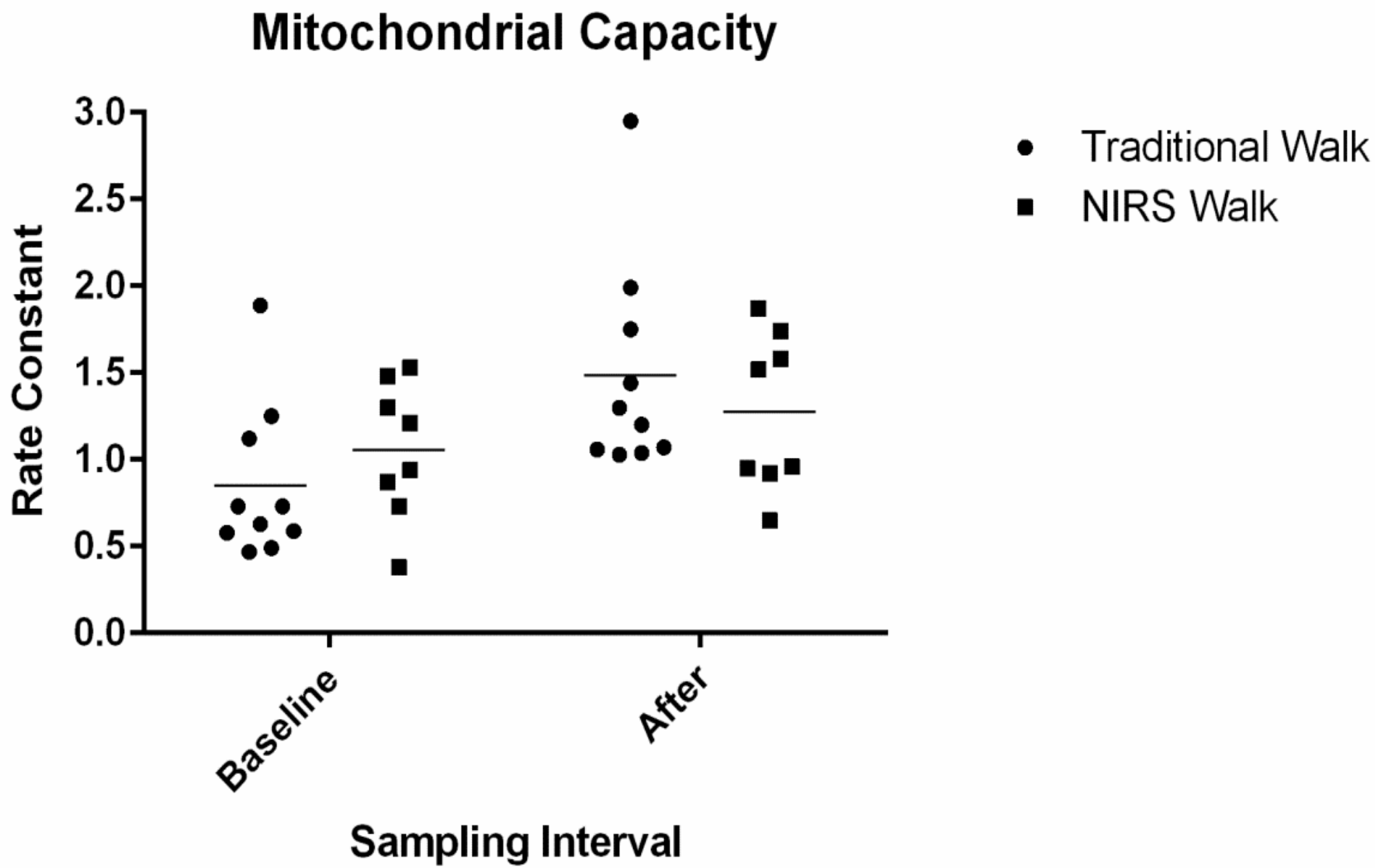


Patient Characteristics

Variable	Traditional (PAIN) Training (N = 10)	NIRS-based Training (N = 8)	p-value
Age	71.6 ± 8.8	72.0 ± 9.7	NS
Gender (%)			
Male	8 (80.0)	6 (75.0)	NS
Female	2 (20.0)	2 (25.0)	NS
BMI	27.4 ± 4.5	29.0 ± 4.6	NS
Diabetes (%)	4 (40.0)	3 (37.5)	NS
Average Daily Steps	2813 ±1949	3405 ±1676	NS
Progressive Walking Test			
Time to First Symptoms (min)	2.5 ± 2.5	4.0 ± 1.9	0.18*
Total Walking Time (min)	8.5 ± 4.3	8.7 ± 3.0	0.9*


Work
Patient ID
kpm
NIRS 6
NIRS 8
NIRS 10
NIRS 15
NIRS 16
NIRS 21
NIRS 33
Traditional 1
Traditional 2
Traditional 13
Traditional 18
Traditional 19
Traditional 22
Traditional 23
Traditional 24
Traditional 31
Traditional 32


Symptom Free Walking Time
14
12
10
8
6
4
2
0
Time (Min)
NIRS
PAIN
Baseline
12 weeks


Mitochondrial Capacity
Rate Constant
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Baseline
After
Sampling Interval
Traditional Walk
NIRS Walk

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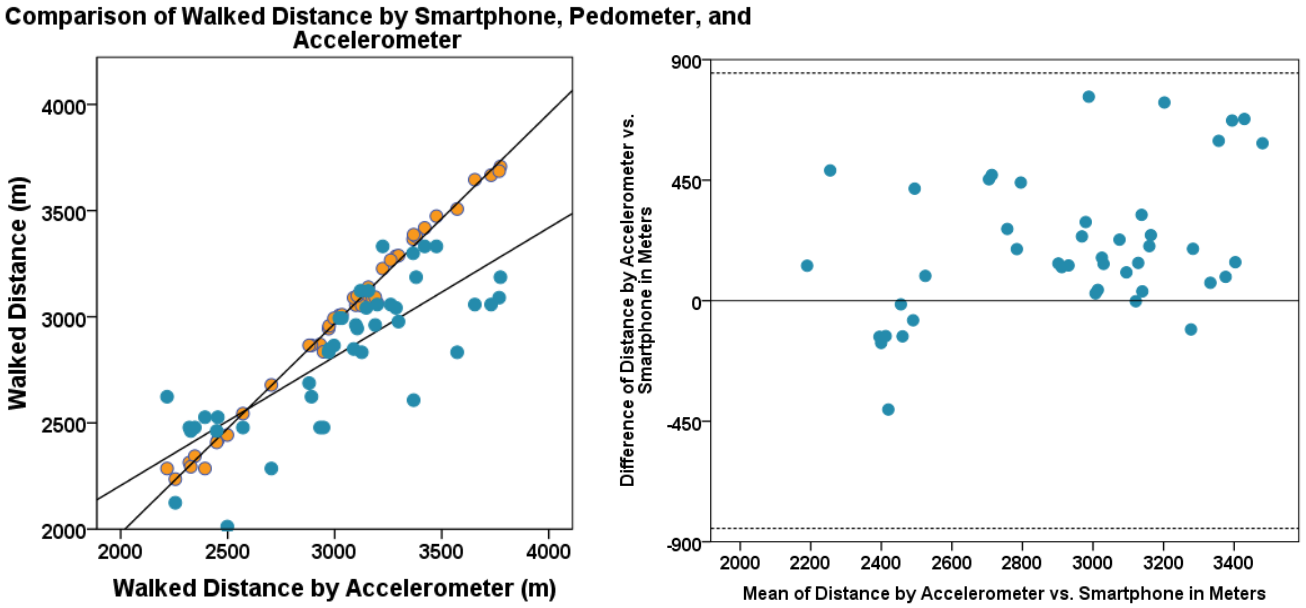
Quantifying Physical Activity
Is there an App for that?

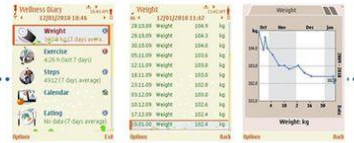
B. Parker Smith, BS and Jonathan R. Murrow, MD
GHSU/UGA Medical Partnership, Athens, GA

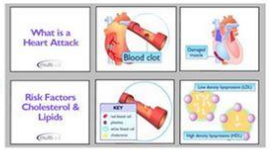
Variable	Measurement
Age	21-29
Gender	50% female
Minutes Walked per session	30.8 ± 2.8
iPhone Distance (meters)	2872 ± 481
Pedometer Distance (meters)	2992 ± 422
Accelerometer Distance (meters)	3022 ± 421



Frequency of expected use and delivery of applications and multimedia content, respectively, via the smartphone for the intervention group attending a 6-week home-based cardiac rehabilitation programme.

Cardiac Rehabilitation week	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Mentoring sessions themes	Getting started Safety issues Chest Pain Medication Heart attack Goal setting	Activity Angina Smoking Worries Anxiety Relaxation	Sleep Relationship Family Sex Activity Depression	Weight issues Diet Exercise Smoking and medication	Cholesterol High blood pressure Diabetes Exercise Medication	Flu/ Pneumonia Exercise CPR Alcohol
StepCounter	Continuous use					
WellnessDiary	Daily entries					
Tele & Video conference (Mentor) Goals and Plans	Once a week					
SMS (text messages)	2/4 Per day					
Video clips	1 to 2 Per week					
Relaxation Audio	Every day					





Marlien Varnfield et al. Heart 2014;100:1770-1779

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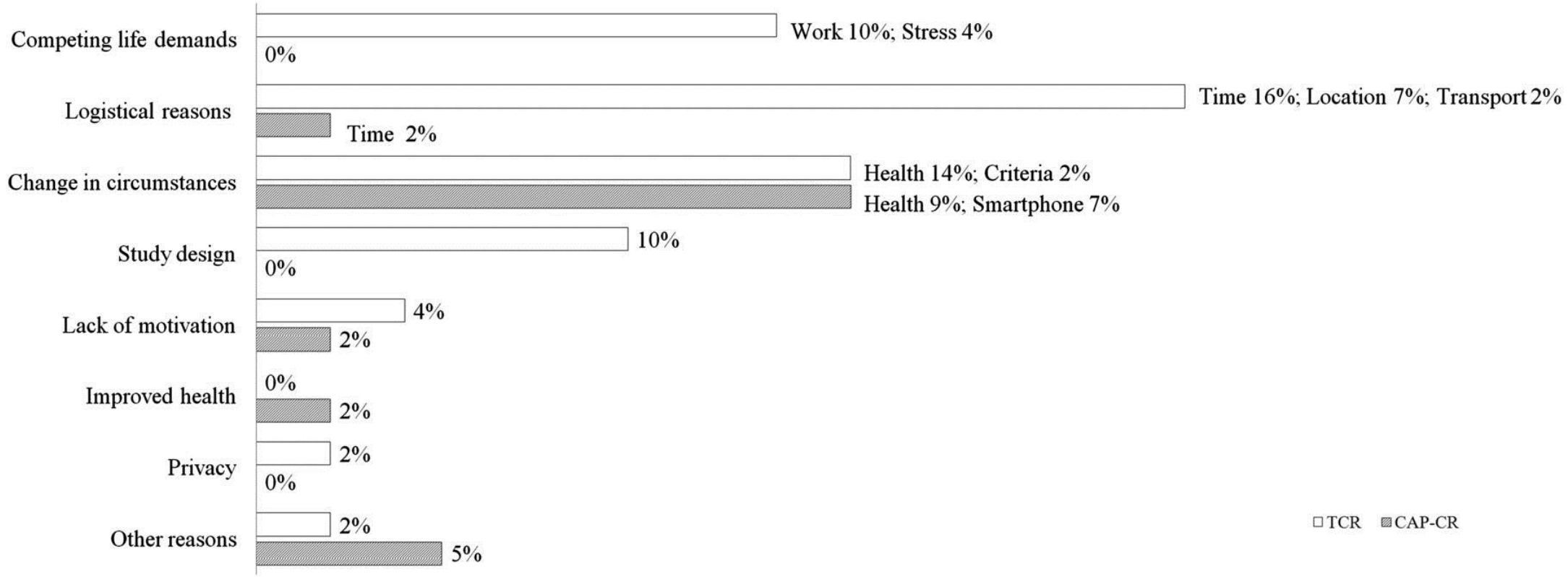
Percentage of dropouts from the traditional and Care Assessment Platform-cardiac rehabilitation, intervention cardiac rehabilitation programmes per primary reported reason (n=44).



Marlien Varnfield et al. Heart 2014;100:1770-1779

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Heart

User Preferences for Mobile Health Interventions: A Survey Among Intermittent Claudication Patients and Their Physical Therapists

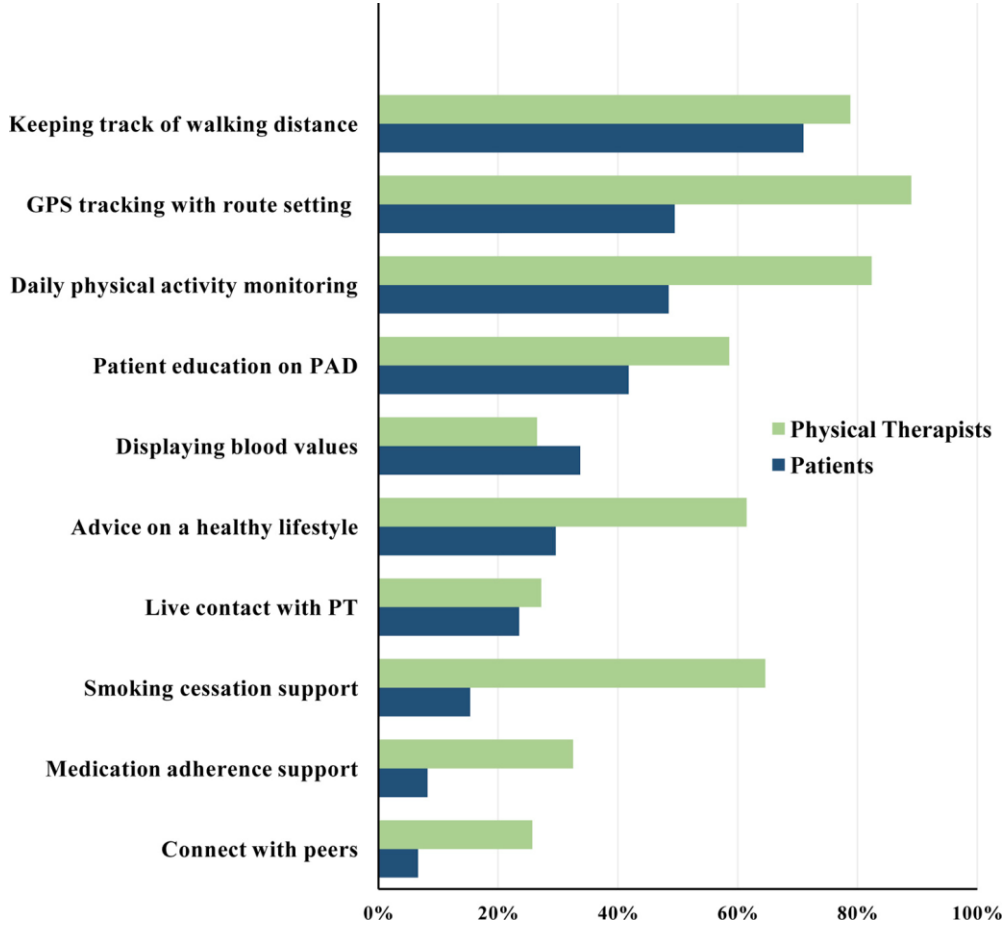

Figure 2. Preferred smartphone app components of patients (n=196) and physical therapists (n=584) who own a smartphone. Abbreviations: GPS, global positioning system; PAD, peripheral arterial disease; PT, physical therapist.

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