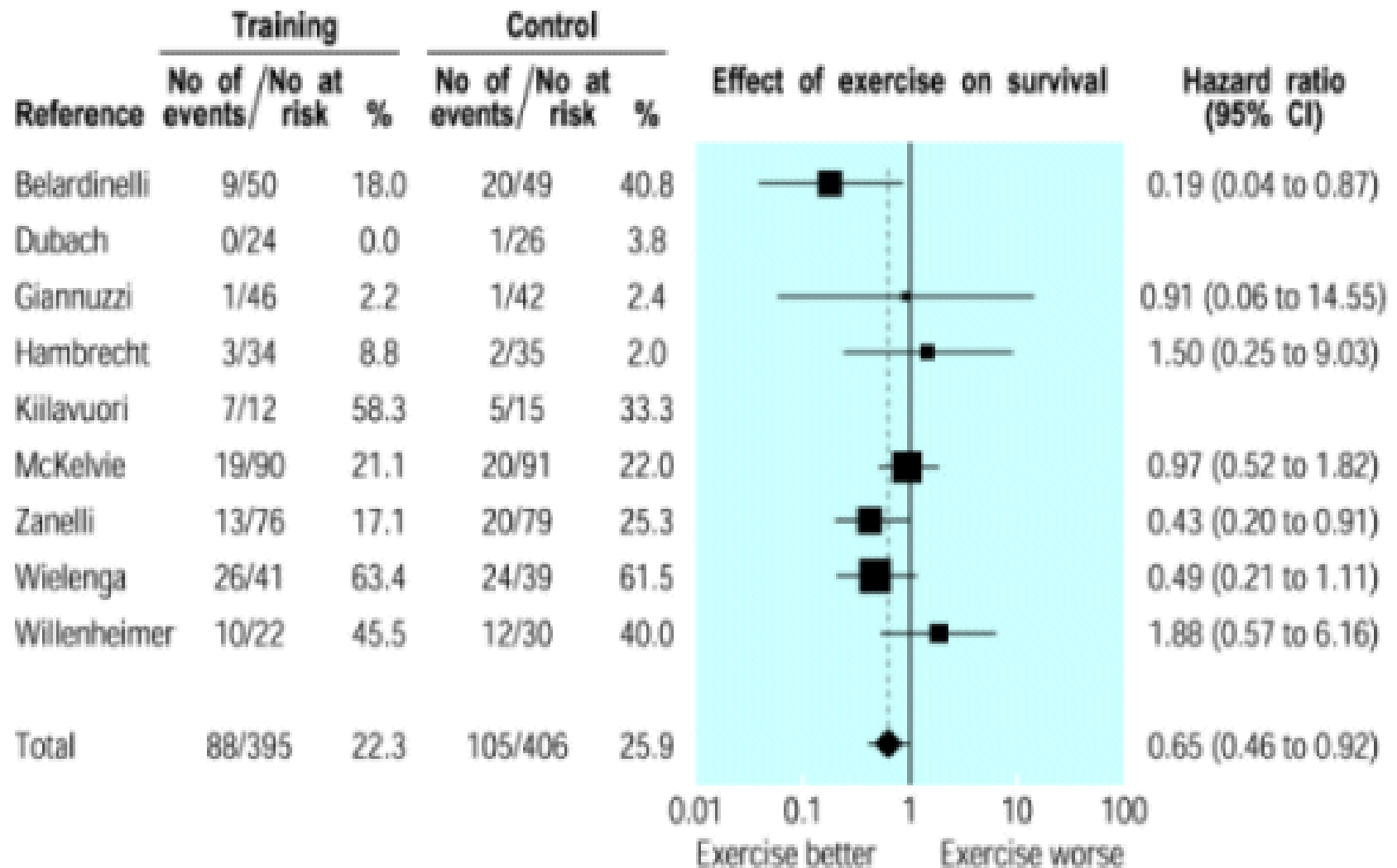# Hybrid Cardiac Rehabilitation in Patients with Heart Failure
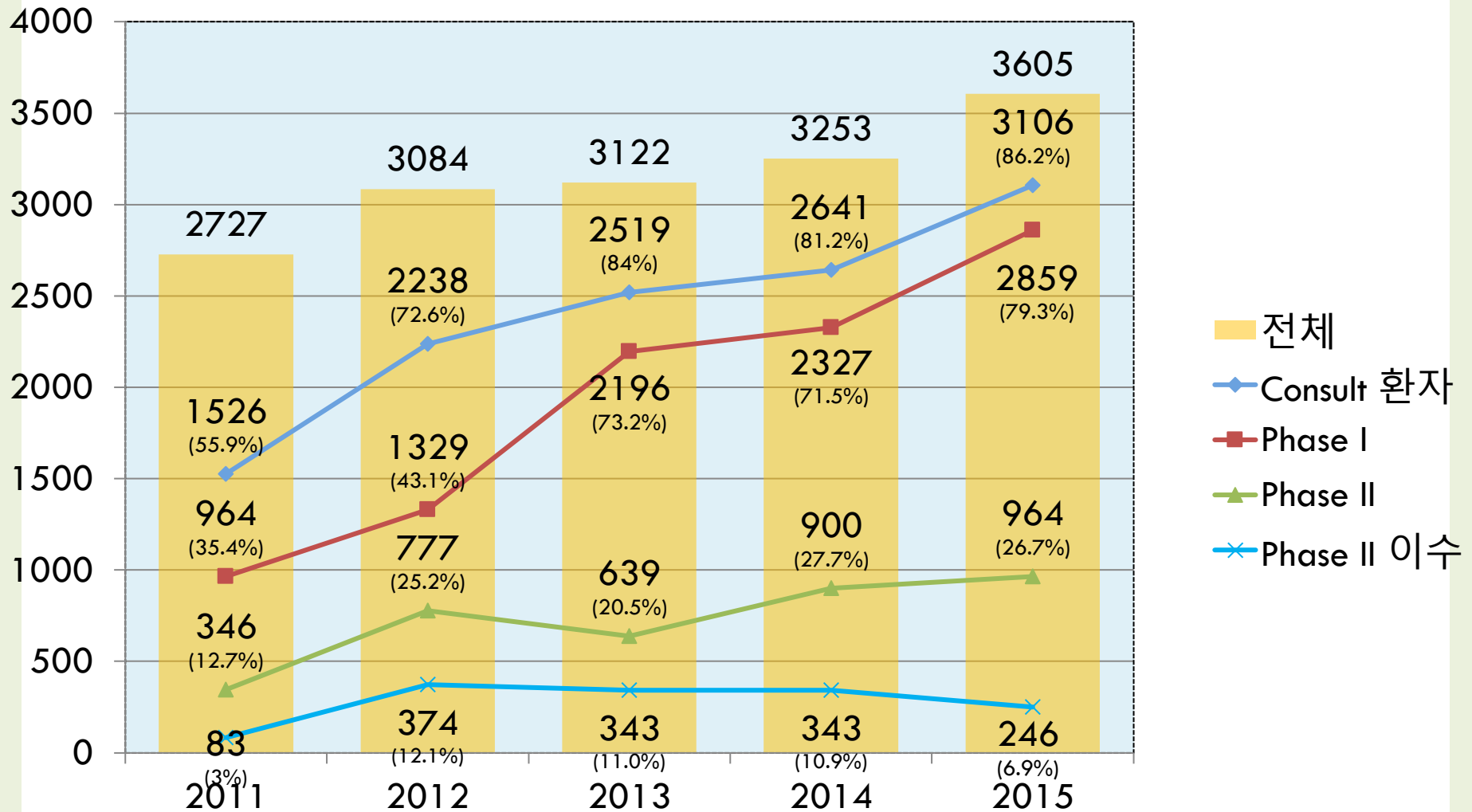
Jidong Sung MD, MPH, PhD
Division of Cardiology
Sungkyunkwan University School of Medicine

The effect of exercise training on risk of death in patients with heart failure

	Training			Control			Effect of exercise on survival	Hazard ratio (95% CI)
Reference	No of events/	No at risk	%	No of events/	No at risk	%		
Belardinelli	9/50		18.0	20/49		40.8		0.19 (0.04 to 0.87)
Dubach	0/24		0.0	1/26		3.8		
Giannuzzi	1/46		2.2	1/42		2.4		0.91 (0.06 to 14.55)
Hambrecht	3/34		8.8	2/35		2.0		1.50 (0.25 to 9.03)
Kiilavuori	7/12		58.3	5/15		33.3		
McKelvie	19/90		21.1	20/91		22.0		0.97 (0.52 to 1.82)
Zanelli	13/76		17.1	20/79		25.3		0.43 (0.20 to 0.91)
Wielenga	26/41		63.4	24/39		61.5		0.49 (0.21 to 1.11)
Willenheimer	10/22		45.5	12/30		40.0		1.88 (0.57 to 6.16)
Total	88/395		22.3	105/406		25.9		0.65 (0.46 to 0.92)

0.01 0.1 1 10 100

Exercise better Exercise worse

심장재활 참여 환자 현황
(권역별 심뇌혈관센터)

Home-based program

- Reasonable alternative in relatively low-risk patients
- Components
  - Regular clinic follow-up
  - Planned communication
  - Management by rehabilitation nurses and other specially trained personnel
  - Periodic trans-telephonic ECG monitoring → recently, using IT-based technology
- Comparable (to conventional supervised program) improvements in functional capacity, without reported complications

Examples of wearable devices used in health and cardiovascular disease
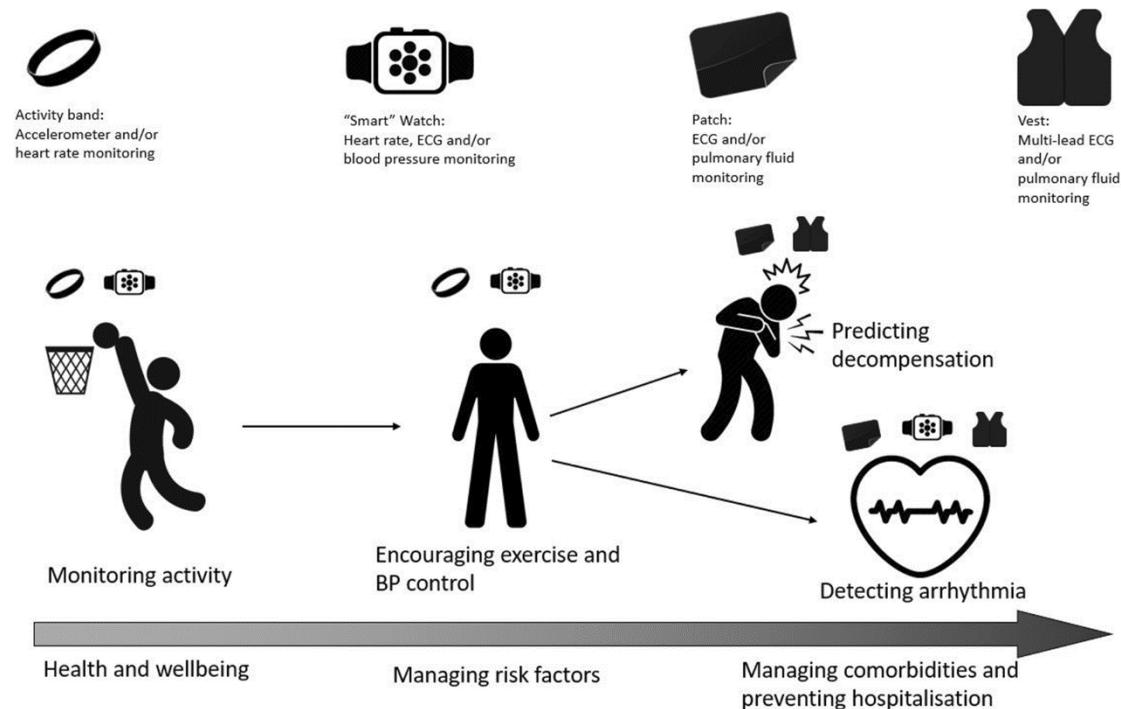
심장재활 임상진료지침

▶ 외국 임상진료지침 권고사항
스코틀랜드(SIGN 2017) (권고강도 Conditional / 근거수준 1++)
1) Technology-based interventions should be considered for patients participating in cardiac rehabilitation.
2) Psychoeducation (goal setting, self-monitoring) should be considered for patients in cardiac rehabilitation to

facilitate adherence to physical activity

국내 진료지침:

권고사항

6. 교육 효과의 유지를 위하여 정보통신기술(IT-based modality)을 이용한 중재를 고려한다.
   (권고강도: C 조건부 권고, 근거수준: 1-)

Hybrid Cardiac Rehabilitation

- A combination of center-based and home-based counseling and exercise (CBCR & HBCR)
- No standardized protocol
- Core components should be included:
    - baseline patient assessment
    - nutritional evaluation and counseling
    - risk factor management (weight management, blood pressure, lipids, and diabetes)
    - tobacco cessation counseling
    - psychosocial assessment and management
    - physical activity (PA) counseling
    - exercise training.
- Monitoring of HBCR
    - Live remote monitoring
   - Delayed review or CR data

Clinical trials of hybrid CR

First Author	Year	Patients (N)	Age (mean ± SD)	Women	Non-White race or ethnicity	Cardiac pathologies included	LVEF inclusion criteria	LVEF (mean ± SD)	Comparator groups	Participant non-completion, hybrid CR vs comparator
Campo	2020	235	76 ± 5	23%	NR	Hospitalized for ACS	≥30%	50 ± 5	Hybrid vs usual care	5.1% vs. 6.0%
Carlson	2000	80	59 ± 9	18%	NR	CABG (29%) Angioplasty (38%) MI (29%) Positive angiography (5%)	None	NR	Hybrid vs center-based	NR
Kitzman	2021	349	72 ± 8	52%	49%	Hospitalized for HF	None	NR[a]	Hybrid vs usual care	14.9% vs 10.9%
Kraal	2017	90	59 ± 8	11%	NR	ACS (59%) Stable angina (12%) CABG (29%)	≥45%	NR	Hybrid vs center-based	17.8% vs 8.9%
Marchionni	2003	270	69 ± 9	23%	NR	≤6 weeks post MI	≥45%	51 ± 1	Hybrid vs center-based	17.8% vs 12.2%
O'Connor	2009	2331	59 ± 12	28%	39%	Outpatients with HF	≤35%	25 ± 8	Hybrid vs usual care	7.3% vs 5.4%
Piotrowicz	2019	850	62 ± 10	16%	NR	Outpatients with HF	≤40%	31 ± 7	Hybrid vs usual care	9.2% vs 7.1%
Schuler	1992	92	53 ± 6	0%	NR	Stable angina	≥35%	56 ± 9	Hybrid vs usual care	23.2% vs 15.8%
Yu	2003	122	61 ± 10	21%	NR	≤6 weeks post MI (64%) ≤6 weeks post elective PCI (36%)	None	NR	Hybrid vs usual care	NR

Abbreviations: ACS, acute coronary syndrome; CABG, coronary artery bypass grafting; CR, cardiac rehabilitation; HF, heart failure; LVEF, left ventricular ejection fraction; NR, not reported; PCI, percutaneous coronary intervention; SD, standard deviation.
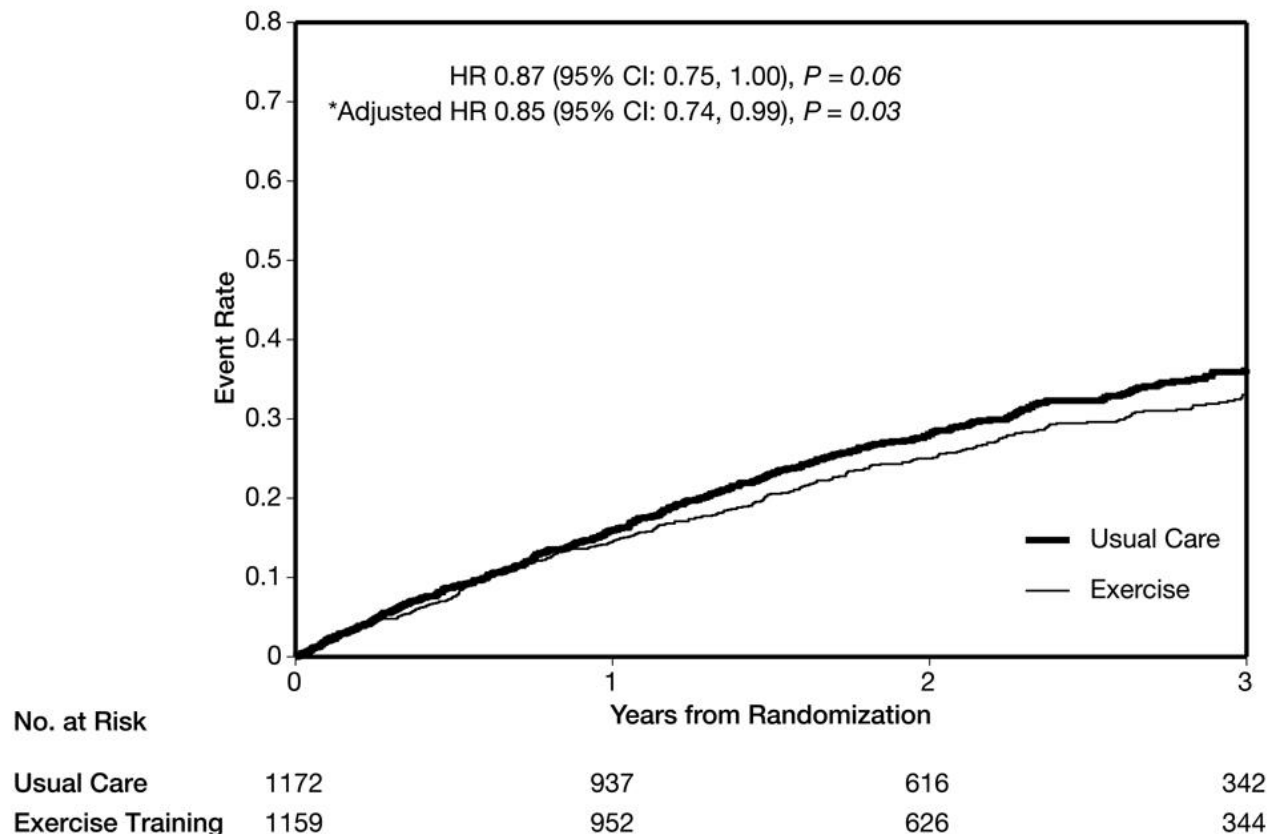
[a] Kitzman et al. reported 47% of included patients had an LVEF ≤45%. The remainder were diagnosed with heart failure with preserved ejection fraction.

HF-ACTION:
Flow of Participants
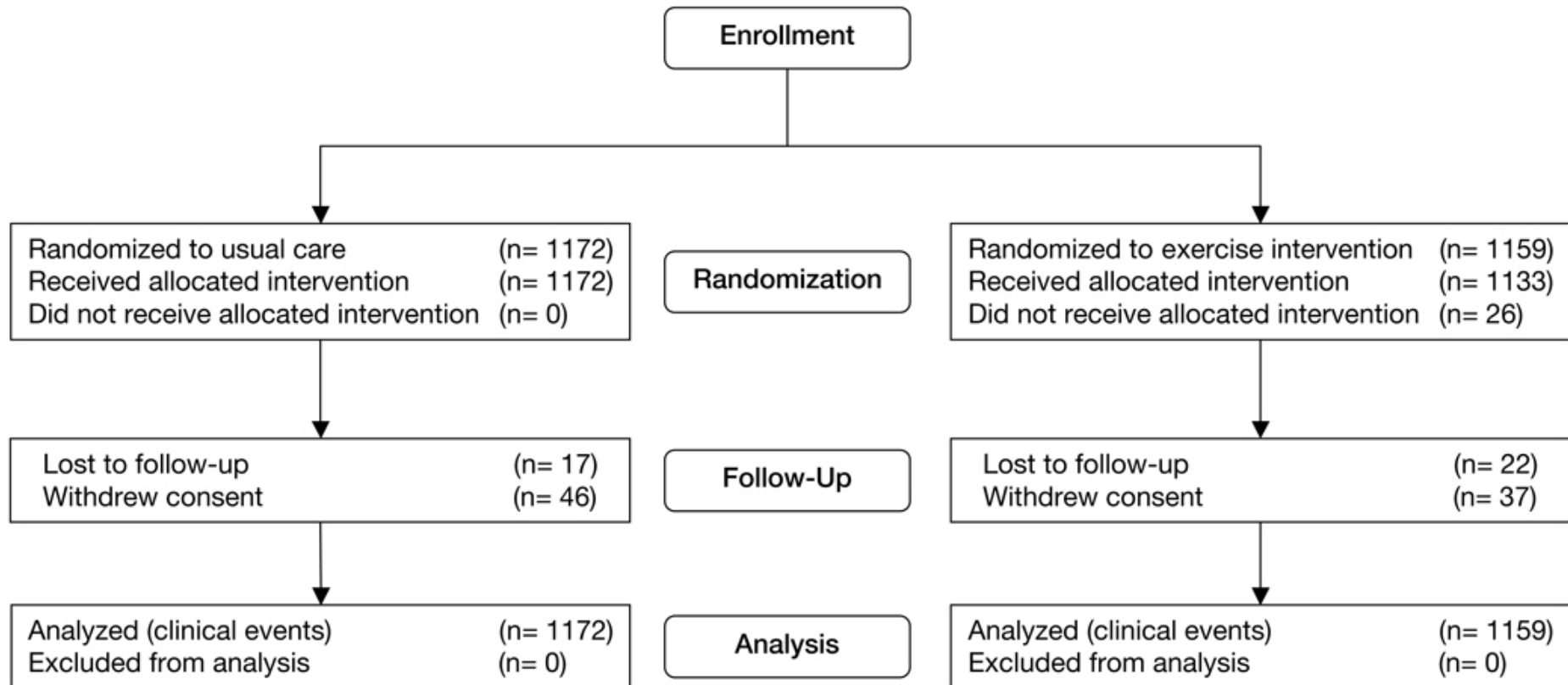
HF-ACTION:
(mortality + hospitalization)

13% reduction of composite primary end point

*Adjusted for key prognostic factors

HF-ACTION: Why???

▶ Optimal medical care
▶ Poor adherence of home-based program
  ▶ average exercise time in training group 60 min/wk (120 min/wk expected)
  ▶ relatively low gain in peak Vo_2 in the training group (0.6 ml/kg/min = 4% increase): average 17% increase in other controlled studies
▶ Cross-over of usual care group
  ▶ at least 8% was doing exercise on their own
  ▶ In usual care group, 55% of patients were dissatisfied with treatment assignment. (2% in exercise group)

HF-ACTION:
Adherence to prescribed exercise
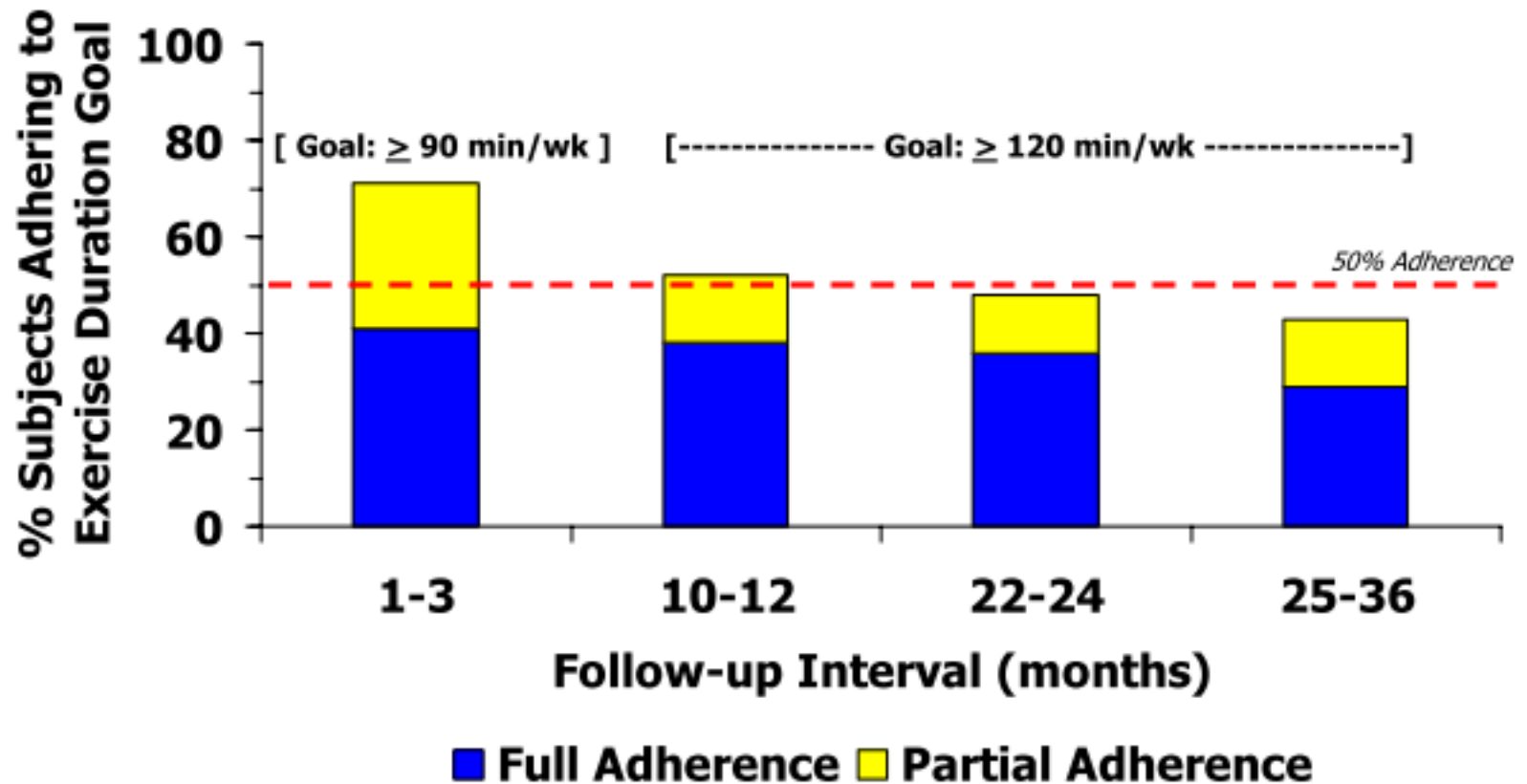
HF-ACTION:
Patient-reported health status

KCCQ Scale	Usual Care (n = 1171)[b]		Exercise Training (n = 1159)		Between-Group Differences in Changes (95% CI)	P Value[c]
	Parameter Estimate (95% CI)	P Value[c]	Parameter Estimate (95% CI)	P Value[c]		
Overall summary scale						
Baseline to 3-month visit	3.28 (2.48 to 4.09)	<.001	5.21 (4.42 to 6.00)	<.001	1.93 (0.84 to 3.01)	<.001
3-Month visit to end of study	−0.01 (−0.05 to 0.03)	.68	0.00 (−0.04 to 0.03)	.89	0.01 (−0.05 to 0.06)	.85
Physical limitations subscale						
Baseline to 3-month visit	1.25 (0.30 to 2.20)	.01	3.55 (2.62 to 4.48)	<.001	2.30 (1.05 to 3.56)	<.001
3-Month visit to end of study	−0.06 (−0.10 to −0.02)	.006	−0.05 (−0.10 to −0.01)	.01	0.01 (−0.05 to 0.07)	.84
Symptoms subscale						
Baseline to 3-month visit	2.06 (1.21 to 2.92)	<.001	3.58 (2.74 to 4.42)	<.001	1.52 (0.40 to 2.65)	.008
3-Month visit to end of study	−0.03 (−0.07 to 0.01)	.14	−0.03 (−0.07 to 0.01)	.10	0.00 (−0.06 to 0.05)	.91
Quality-of-life subscale						
Baseline to 3-month visit	5.73 (4.70 to 6.77)	<.001	7.36 (6.35 to 8.38)	<.001	1.63 (0.26 to 2.99)	.02
3-Month visit to end of study	0.08 (0.03 to 0.12)	<.001	0.09 (0.05 to 0.14)	<.001	0.02 (−0.05 to 0.08)	.61
Social limitations subscale						
Baseline to 3-month visit	4.50 (3.32 to 5.67)	<.001	6.28 (5.13 to 7.44)	<.001	1.79 (0.24 to 3.34)	.02
3-Month visit to end of study	−0.04 (−0.09 to 0.01)	.16	0.02 (−0.03 to 0.07)	.44	0.06 (−0.01 to 0.13)	.12

Abbreviations: CI, confidence interval; KCCQ, Kansas City Cardiomyopathy Questionnaire.
[a] Estimates are derived from a longitudinal piecewise linear mixed model that adjusts for ischemic etiology of heart failure. The models estimate change from baseline to 3 months and monthly change from 3 months to the end of study for each treatment group.
[b] Follow-up data forms were not available for 1 patient.
[c] P values are from t tests for null hypotheses that parameter estimates were equal to zero.

JAMA. 2009;301:1451-1459

심장재활의 임상현장 및 지역사회 이행제고 전략개발 연구

- 제 2 세부과제
  - 심부전환자의 심장재활 프로그램 참여율 및 이행율 제고 방안 개발 및 타당성 검증
  - 한국 진료 현장에서 적합하고 유효한 hybrid CR 프로그램의 확립
  - Not randomized trial, adopted quasi-experimental design

PICO

▶ P: 삼성서울병원에 입원치료를 받는 심부전환자
(심장이식, LVAD 시술 등 포함, 외래 심장재활 프로그램에 내원한 환자 포함)

▶ I: Hybrid type comprehensive cardiac rehabilitation

  ▶ Center-based + home-based mixed

  ▶ Monitoring method for HBCR:
    telephone follow-up ± physical activity monitoring

▶ C: Usual care (심장재활 시행치 않음)

▶ O: <u>Primary outcome</u>

  ▶ 총 사망 + 입원

  ▶ 운동능력: 6분 걷기 또는 심폐기능검사 (시행할 수 있는 경우에)

  ▶ 퇴원 후 외래 심장재활 참여 여부 및 이행률 (center-based session 참여 횟수, home-based program 이행은 설문과 device를 이용한 활동량 측정)

▶ <u>Secondary outcome:</u> psycho-social outcomes

  ▶ 삶의 질 (generic & disease-specific)

  ▶ 우울 및 불안

  ▶ 직업 및 일상생활 복귀

Baseline characteristics

Variables	Total	Intervention	Control	*p*
N	78	49	29	
Age (years)	60.3 ± 12.4 (78)	55.6 ± 12.0 (49)	68.4 ± 8.5 (29)	< 0.0001
Female (%)	32.1 (25/78)	30.6 (15/49)	34.5 (10/29)	0.92
Duration of HF (years)	0.8 (0.0 - 5.0) (74)	0.5 (0.0 - 2.9) (49)	2.2 (0.0 - 5.6) (25)	0.32
Hypertension (%)	50.6 (39/77)	46.9 (23/49)	57.1 (16/28)	0.53
DM (%)	28.2 (22/78)	18.4 (9/49)	44.8 (13/29)	< 0.05
Current Smoking (%)	5.7 (4/70)	2.0 (1/49)	14.3 (3/21)	0.14
Body mass index (%)	23.4 ± 3.5 (78)	23.4 ± 4.0 (49)	23.3 ± 2.7 (29)	0.95
Muscle mass (kg)	25.2 ± 6.6 (36)	25.0 ± 6.8 (34)	27.5 ± 2.1 (2)	
Residence in Seoul (%)	30.8 (24/78)	44.9 (22/49)	6.9 (2/29)	< 0.01
Duration of admission (days)	11.0 (6.0 - 21.0) (78)	11.0 (5.0 - 20.0) (49)	11.0 (8.0 - 22.0) (29)	0.36
Previous PCI (%)	29.5 (23/78)	26.5 (13/49)	34.5 (10/29)	0.63
Inpatient CR (%)	85.9 (67/78)	79.6 (39/49)	96.6 (28/29)	
Outpatient CR (%)	55.3 (42/76)	75.5 (37/49)	18.5 (5/27)	< 0.0001
Activity tracking (%)	51.3 (40/78)	79.6 (39/49)	3.4 (1/29)	< 0.0001
6 MWD (m)	391.2 ± 132.4 (43)	394.0 ± 128.3 (34)	380.6 ± 154.8 (9)	1.00
CCI	2.3 ± 1.5 (78)	2.1 ± 1.3 (49)	2.7 ± 1.7 (29)	0.13
KASI score	42.9 ± 19.3 (52)	43.0 ± 18.2 (47)	42.4 ± 30.7 (5)	0.89
eq_vas	71.8 ± 18.4 (52)	73.0 ± 17.1 (47)	61.0 ± 28.8 (5)	0.39
PHQ9 score	17.0 ± 5.5 (52)	16.9 ± 5.2 (47)	17.8 ± 8.9 (5)	0.91
MLWHFQ score	67.4 ± 26.4 (52)	67.5 ± 26.6 (47)	66.0 ± 27.4 (5)	0.70

Data at 3 months follow-up

Variables	Total	Intervention	Control	p
N	57	39	18	
Center-based CR attendance no.	4.4 ± 7.7 (57)	6.3 ± 8.7 (39)	0.3 ± 1.4 (18)	< 0.05
Return to work (%)	34.9 (15/43)	39.5 (15/38)	0 (0/5)	0.14
ER visit (%)	5.5 (3/55)	2.6 (1/39)	12.5 (2/16)	0.20
Readmission (%)	14.5 (8/55)	7.7 (3/39)	31.2 (5/16)	< 0.05
All-cause death (%)	0 (0/55)	0 (0/39)	0 (0/16)	
Cardiovascular death(%)	0 (0/55)	0 (0/39)	0 (0/16)	
6 MWD (m)	449.6 ± 124.9 (40)	453.9 ± 125.4 (36)	411.2 ± 131.2 (4)	< 0.0001
CCI	2.1 ± 1.3 (57)	2.1 ± 1.3 (39)	2.1 ± 1.4 (18)	< 0.001
KASI score	54.5 ± 13.6 (38)	55.0 ± 13.4 (37)	35.7 ± 0 (1)	< 0.0001
eq_vas	78.4 ± 17.1 (38)	79.2 ± 16.6 (37)	50.0 ± 0 (1)	< 0.0001
PHQ9 score	14.3 ± 5.7 (38)	14.5 ± 5.7 (37)	9.0 ± 0 (1)	< 0.0001
MLWHFQ score	45.2 ± 20.9 (38)	45.0 ± 21.2 (37)	52.0 ± 0 (1)	< 0.0001

Baseline characteristics
of the non-participants

Variables	Total	Study	Registry	p
N	113	62	51	
Age (years)	63.5 ± 12.9 (113)	58.0 ± 11.9 (62)	70.2 ± 10.9 (51)	< 0.0001
Female (%)	29.2 (33/113)	27.4 (17/62)	31.4 (16/51)	0.80
Duration of HF (years)	0.7 (0.0 - 3.9) (111)	1.0 (0.0 - 5.4) (62)	0.5 (0.0 - 2.5) (49)	0.40
Hypertension (%)	56.6 (64/113)	45.2 (28/62)	70.6 (36/51)	< 0.05
DM (%)	38.1 (43/113)	22.6 (14/62)	56.9 (29/51)	< 0.001
Current Smoking (%)	8.0 (9/113)	3.2 (2/62)	13.7 (7/51)	0.09
Body mass index (%)	22.6 ± 3.8 (112)	23.3 ± 3.6 (62)	21.9 ± 3.9 (50)	0.05
Residence in Seoul (%)	33.6 (38/113)	35.5 (22/62)	31.4 (16/51)	0.79
Duration of admission (days)	11.0 (6.0 - 21.0) (113)	11.0 (5.2 - 20.8) (62)	10.0 (6.0 - 23.0) (51)	0.88
Previous PCI (%)	27.4 (31/113)	27.4 (17/62)	27.5 (14/51)	1.00
CRT(%)	6.2 (7/113)	9.7 (6/62)	2.0 (1/51)	0.19
LVAD (%)	9.7 (11/113)	12.9 (8/62)	5.9 (3/51)	0.35
Heart transplantation (%)	4.4 (5/113)	3.2 (2/62)	5.9 (3/51)	0.82
Inpatient CR (%)	86.7 (98/113)	85.5 (53/62)	88.2 (45/51)	0.88
Outpatient CR (%)	47.8 (54/113)	77.4 (48/62)	11.8 (6/51)	< 0.0001
6 MWD (m)	407.7 ± 128.0 (39)	404.6 ± 129.0 (37)	465.5 ± 129.4 (2)	0.68
CCI	2.6 ± 1.6 (113)	2.4 ± 1.6 (62)	2.9 ± 1.5 (51)	< 0.05

The Rehabilitation Therapy in Older Acute Heart Failure Patients (REHAB-HF) trial

Physical Rehabilitation for Older Patients Hospitalized for Heart Failure

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ABSTRACT

BACKGROUND

Older patients who are hospitalized for acute decompensated heart failure have high rates of physical frailty, poor quality of life, delayed recovery, and frequent rehospitalizations. Interventions to address physical frailty in this population are not well established.

METHODS

We conducted a multicenter, randomized, controlled trial to evaluate a transitional, tailored, progressive rehabilitation intervention that included four physical-function domains (strength, balance, mobility, and endurance). The intervention was initiated during, or early after, hospitalization for heart failure and was continued after discharge for 36 outpatient sessions. The primary outcome was the score on the Short Physical Performance Battery (total scores range from 0 to 12, with lower scores indicating more severe physical dysfunction) at 3 months. The secondary outcome was the 6-month rate of rehospitalization for any cause.

RESULTS

A total of 349 patients underwent randomization; 175 were assigned to the rehabilitation intervention and 174 to usual care (control). At baseline, patients in each group had markedly impaired physical function, and 97% were frail or prefrail; the mean number of coexisting conditions was five in each group. Patient retention in the intervention group was 82%, and adherence to the intervention sessions was 67%. After adjustment for baseline Short Physical Performance Battery score and other baseline characteristics, the least-squares mean (±SE) score on the Short Physical Performance Battery at 3 months was 8.3±0.2 in the intervention group and 6.9±0.2 in the control group (mean between-group difference, 1.5; 95% confidence interval [CI], 0.9 to 2.0; P<0.001). At 6 months, the rates of rehospitalization for any cause were 1.18 in the intervention group and 1.28 in the control group (rate ratio, 0.93; 95% CI, 0.66 to 1.19). There were 21 deaths (15 from cardiovascular causes) in the intervention group and 16 deaths (8 from cardiovascular causes) in the control group. The rates of death from any cause were 0.13 and 0.10, respectively (rate ratio, 1.17; 95% CI, 0.61 to 2.27).

CONCLUSIONS

In a diverse population of older patients who were hospitalized for acute decompensated heart failure, an early, transitional, tailored, progressive rehabilitation intervention that included multiple physical-function domains resulted in greater improvement in physical function than usual care. (Funded by the National Institutes of Health and others; REHAB-HF ClinicalTrials.gov number, NCT02196038.)

From the Department of Internal Medicine, Sections of Cardiovascular Medicine (D.W.K., M.B.N., B.U.) and Gerontology and Geriatric Medicine (D.W.K., M.A.E.), and the Departments of Neurology (P.D.) and Biostatistics and Data Science (H.C., M.A.E.), Wake Forest School of Medicine, Winston-Salem, the Department of Orthopedic Surgery, Doctor of Physical Therapy Division (A.M.P.), the Department of Medicine, Division of Cardiology (R.J.M.), and the Department of Population Health Sciences (S.D.R.), Duke University School of Medicine, Durham, and Novant Health Heart and Vascular Institute, Charlotte (G.R.R.) — all in North Carolina; the Department of Medicine, Sidney Kimmel Medical College at Thomas Jefferson University (D.J.W.), and the Department of Physical Therapy, Jefferson College of Rehabilitation Sciences at Thomas Jefferson University (L.A.H.) — both in Philadelphia; and Inova Heart and Vascular Institute, Fairfax, VA (C.M.O.). Address reprint requests to Dr. Kitzman at the Department of Internal Medicine, Sections of Cardiovascular Medicine and Gerontology and Geriatric Medicine, Wake Forest School of Medicine, 1 Medical Center Blvd., Winston-Salem, NC 27157-1045, or at dkitzman@wakehealth.edu.

A list of the investigators in this trial is provided in the Supplementary Appendix, available at NEJM.org.

Table 1. Demographic and Clinical Characteristics of the Patients at Baseline.*

Characteristic	Intervention (N=175)	Control (N=174)
Age — yr	73.1±8.5	72.2±7.7
Female sex — no. (%)	85 (49)	98 (56)
Non-White race — no. (%)†	81 (46)	91 (52)
Body-mass index‡	32.9±8.2	33.0±8.9
Ejection fraction ≥45%, indicating preserved ejection fraction — no. (%)	93 (53)	92 (53)
Heart failure caused by ischemic heart disease — no. (%)§	66 (38)	56 (32)
NYHA class — no. (%)		
II	33 (19)	34 (20)
III	100 (57)	90 (52)
IV	41 (23)	51 (29)
Median B-type natriuretic peptide (IQR) — pg/ml¶	595 (259–1292)	645 (381–1072)
Median N-terminal pro–B-type natriuretic peptide (IQR) — pg/ml‖	2527 (1395–4858)	3615 (1874–8637)
Median no. of days hospitalized during index hospitalization (IQR)	4 (3–7)	5 (3–7)
Patients with ≥1 hospitalization in previous 6 mo — no. (%)	76 (43)	80 (46)
Coexisting conditions		
Total no. of coexisting conditions	5.4±2.0	5.0±1.9
Hypertension — no. (%)	159 (91)	162 (93)
History of myocardial infarction — no. (%)	31 (18)	32 (18)
History of coronary revascularization, including PCI and CABG — no. (%)	55 (31)	47 (27)
Atrial fibrillation — no. (%)	89 (51)	87 (50)
Diabetes mellitus — no. (%)	101 (58)	81 (47)
Hyperlipidemia — no. (%)	110 (63)	120 (69)
Depression, according to electronic medical record — no. (%)	29 (17)	33 (19)
Geriatric conditions		
Dementia or cognitive impairment, according to electronic medical record — no. (%)	6 (3)	4 (2)
Frail, as defined by the presence of at least three Fried criteria** — no. (%)	92 (53)	100 (57)
Prefrail, as defined by the presence of one or two Fried criteria** — no. (%)	77 (44)	68 (39)
Urinary incontinence — no./total no. (%)	19/144 (13)	21/142 (15)
Patients with falls in previous 3 mo — no./total no. (%)	24/143 (17)	20/146 (14)

Outcomes

Clinical events at 6 mo*			
No. of patients	174	173	
Rehospitalization for any cause, secondary outcome — no. of events (rate)	194 (1.18)	213 (1.28)	0.93 (0.66 to 1.19)‡‡
Death — no. of events (rate)	21 (0.13)	16 (0.10)	1.17 (0.61 to 2.27)‡‡
Combined rehospitalization for any cause and death — no. of events (rate)	215 (1.31)	229 (1.38)	0.93 (0.77 to 1.12)‡‡
Rehospitalization for heart failure — no. of events (rate)	94 (0.57)	110 (0.66)	0.89 (0.56 to 1.22)‡‡
No. of patients with ≥2 rehospitalizations for any cause (%)	47 (27)	60 (35)	0.71 (0.44 to 1.13)§§
No. of patients with ≥2 rehospitalizations for heart failure (%)	22 (13)	27 (16)	0.78 (0.41 to 1.46)§§
No. of days of rehospitalization for any cause	7.2	7.6	0.92 (0.52 to 1.22)‡‡
No. of patients with ≥1 fall (%)	48 (28)	62 (36)	0.67 (0.42 to 1.06)§§
No. of patients with ≥1 fall that resulted in injury (%)	12 (7)	16 (9)	0.66 (0.30 to 1.47)§§

Table 2. Trial Outcomes.

| Outcome	Intervention (N=175)	Control (N=174)	Effect Size (95% CI)
Outcomes at 3 mo*			
SPPB score, primary outcome†			
At baseline	6.0±2.8	6.1±2.6	
At 3 mo	8.3±0.2	6.9±0.2	1.5 (0.9 to 2.0)‡
No. of patients assessed at 3 mo	149	155	
Balance score			
At baseline	2.6±1.3	2.7±1.3	
At 3 mo	3.2±0.1	2.9±0.1	0.4 (0.1 to 0.6)
4-M walk score			
At baseline	2.3±1.0	2.3±1.0	
At 3 mo	3.0±0.1	2.5±0.1	0.5 (0.2 to 0.7)
Chair rise score			
At baseline	1.1±1.2	1.2±1.2	
At 3 mo	2.1±0.1	1.5±0.1	0.6 (0.4 to 0.9)
6-Min walk distance — m			
At baseline	194±104	193±107	
At 3 mo	293±8	260±8	34 (12 to 56)
No. of patients assessed at 3 mo	135	125	
Gait speed — m/sec			
At baseline	0.60±0.23	0.61±0.22	
At 3 mo	0.80±0.02	0.68±0.02	0.12 (0.07 to 0.16)
No. of patients assessed at 3 mo	146	143	
Hand-grip strength — kg			
Men			
At baseline	30.3±9.5	30.5±10.7	
At 3 mo	30.1±0.7	30.6±0.8	−0.5 (−2.5 to 1.6)
No. of patients assessed at 3 mo	75	63	
Women			
At baseline	20.7±7.3	19.6±6.6	
At 3 mo	21.3±0.6	21.4±0.5	−0.2 (−1.7 to 1.4)
No. of patients assessed at 3 mo	68	76	
Frailty status — no. of modified Fried criteria met§			
At baseline	2.3±1.1	2.4±1.1	
At 3 mo	1.4±0.1	1.6±0.1	−0.3 (−0.5 to 0)
No. of patients assessed at 3 mo	142	129	
KCCQ overall score¶			
At baseline	40±21	42±21	
At 3 mo	69±2	62±2	7.1 (2.0 to 12.2)
No. of patients assessed at 3 mo	147	145	
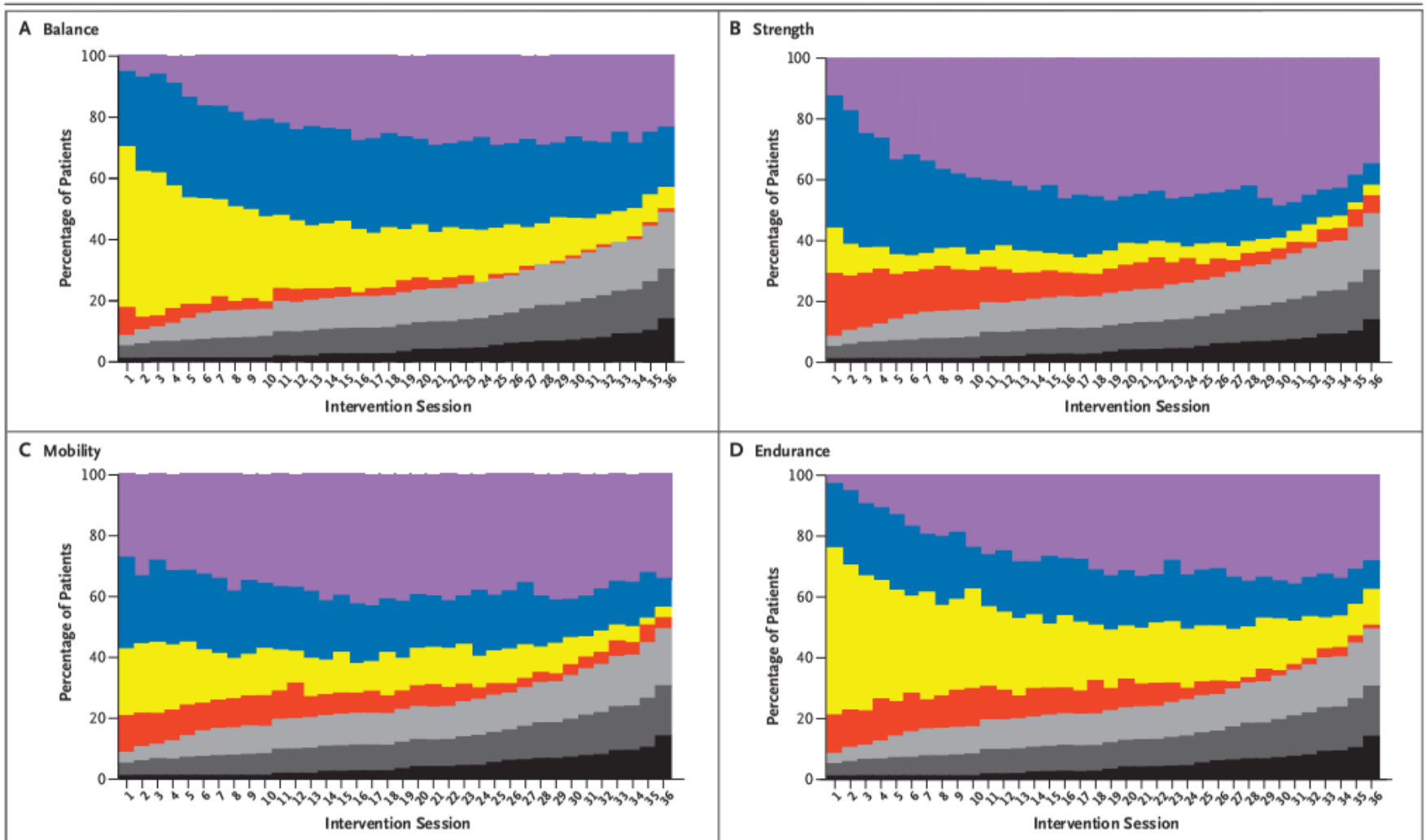
Figure 2. Progression of Physical Function over Time in the Intervention Group, According to Exercise Domain.

As described previously,[17,18] each exercise session comprised four domains (balance, strength, mobility, and endurance) and four stratification levels (level 1, shown in red; level 2, yellow; level 3, blue; and level 4, purple) corresponding to increasing thresholds of functional ability. For all four domains, as the number of sessions increased during the rehabilitation intervention, the percentage of patients who were performing at higher levels of functional ability (levels 3 and 4) generally increased, whereas the percentage of patients who were performing at lower levels (1 and 2) generally decreased. The black, dark gray, and light gray areas indicate the percentages of patients who died, were lost to follow-up, or discontinued the intervention, respectively.

Lessons

▶ Behavioral intervention is definitely more difficult to perform than pharmacological trial.

　▶ Effects depend crucially on patient motivation.

▶ Previous trials frequently exclude elderly patients with multiple comorbidities or frailty.

▶ The patients with the greatest need are rarely studied.

What should be done?

▶ Adherence is important!
  ▶ Alternatives?
  ▶ Proper monitoring, follow-up & encouragement
  ▶ Mobile technology
▶ Need to achieve actual improvement of aerobic fitness