Chronic Respiratory Disease

Pulmonary Rehabilitation

Sung-Soon Lee, MD

Department of Medicine, Ilsan Paik Hospital
Clinical Research Center
for Chronic Obstructive Airway Disease

보건복지부 보건의료기술진흥사업 연구 지원 A040153

Definition of PR

Evidence-based,

Multidisciplinary,

Comprehensive intervention

Patients with **chronic respiratory diseases**

Who are **symptomatic** and
often have **decreased daily life activities**.

Definition of PR

- Integrated into the **individualized treatment** of the patient
- PR is designed to
  reduce **symptoms**
  optimize **functional status**
  increase **participation**
  reduce **health care costs**
  through stabilizing or reversing systemic manifestations of the disease

Benefits of PR

Evidence A

- Improves **exercise capacity**
- Reduces the intensity of **breathlessness**
- Improve health-related **quality of life**
- Reduces the number of **hospitalizations**
- Reduces anxiety and **depression**

Evidence B

- Improves **survival**

Effect of PR

- Reduce dyspnea
- Increase **exercise performance**
- Improve health-related quality of life (HRQL).
- Reduce **health care costs**

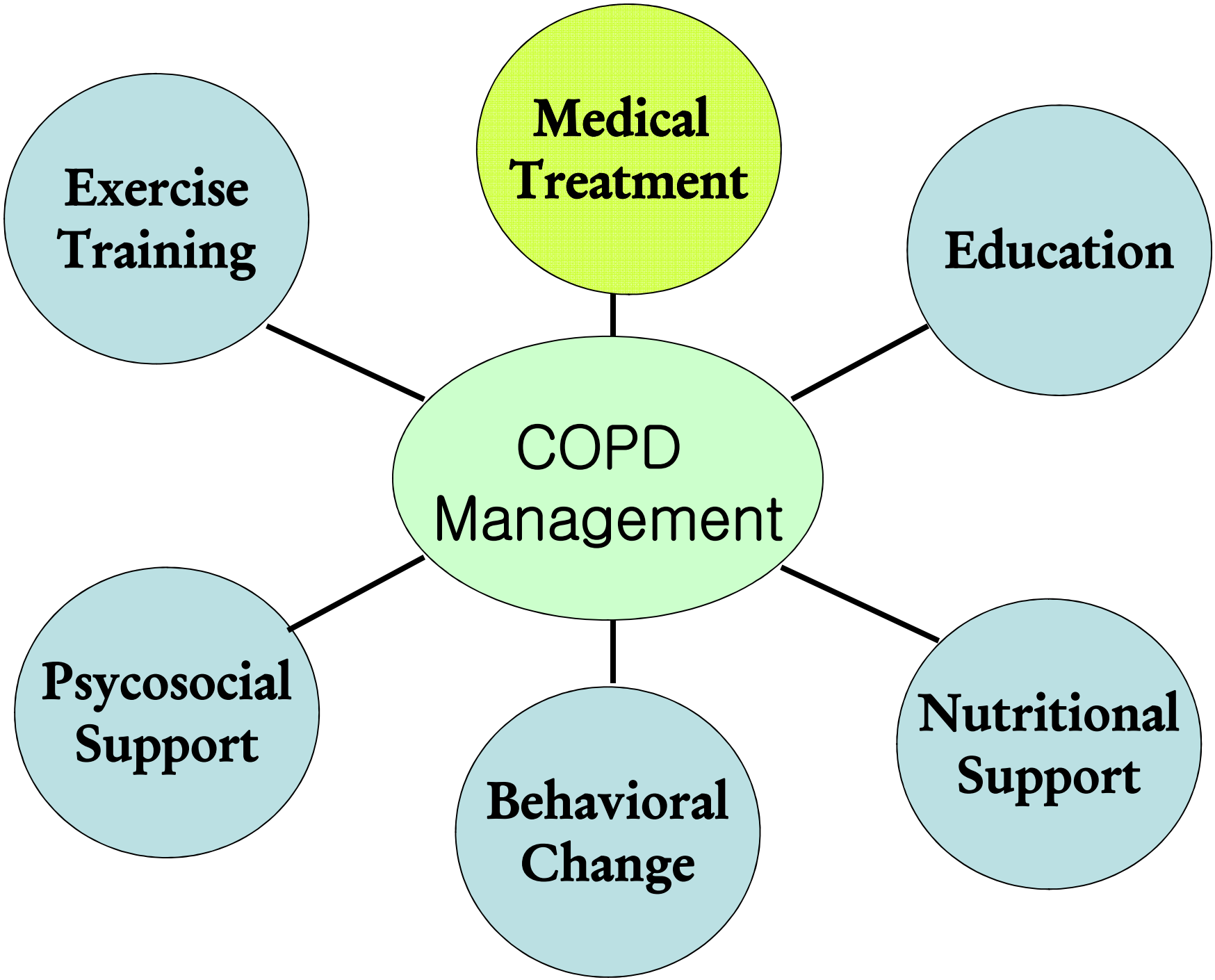
Chronic Respiratory Disease

Symtom, Dyspnea, Exercise capacity

vs Pulmonary function

Chronic Respiratory Disease

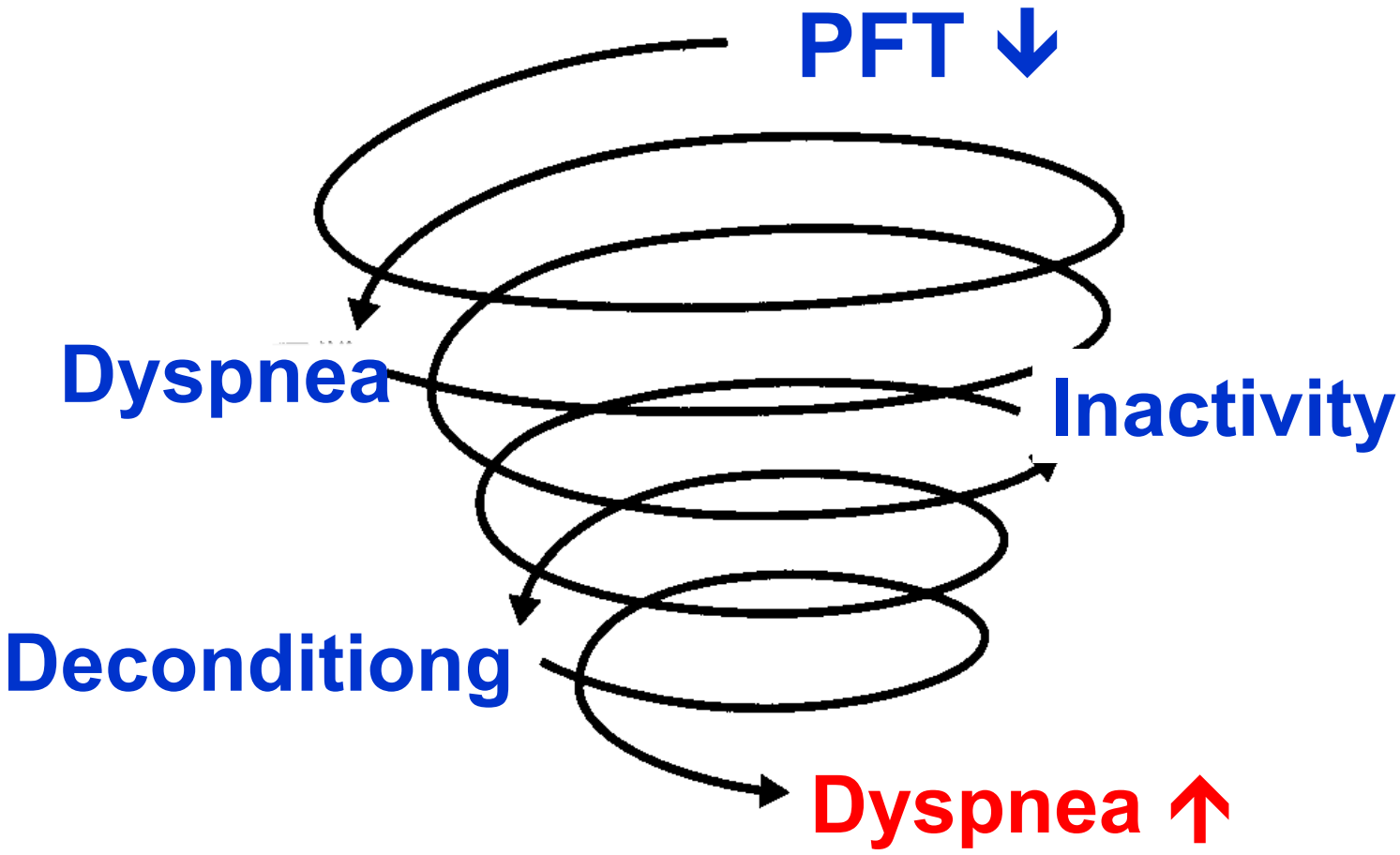
- **COPD**
- **Tuberculosis Destroyed Lung**
- **Bronchiectasis**
- **Bronchial asthma**
- **Idiopathic Pulmonary Fibrosis**
- **Pneumoconiosis**


Medical Treatment
Exercise Training
Education
COPD Management
Psycosocial Support
Behavioral Change
Nutritional Support

Component of PR

- **Education**
- **Assessment**
- **Exercise program**
  - Endurance training
  - Strength training
  - Respiratory muscle training
- **Psychological** support
- **Nutritional** support

The Cycle of Physical, Social, and Psychosocial Consequences of COPD



Exercise Intolerance in COPD

- Ventilatory limitation
- Gas exchange limitation
- Cardiac dysfunction
- Skeletal muscle dysfunction
- Respiratory muscle dysfunction

Ventilatory limitation

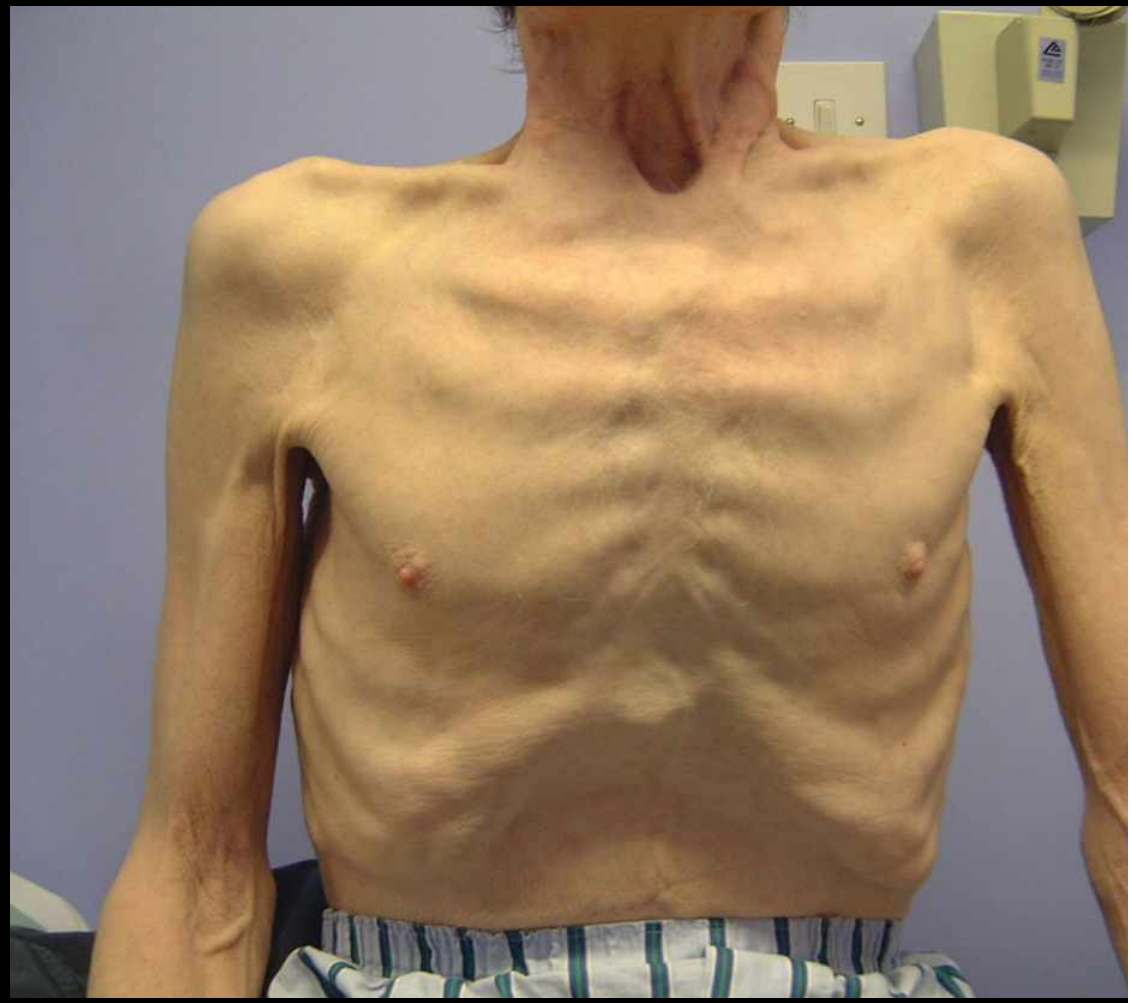
- Increased dead-space ventilation
- Impaired gas exchange
- Increased ventilatory demands
- Dynamic hyperinflation

Gas exchange limitation

- Hypoxia increases pulmonary ventilation
- Supplemental oxygen
  →decrease in dynamic hyperinflation by lowering respiratory rate
  → decrease in pulmonary artery pressures

Skeletal Muscle Dysfunction

- **Inactivity**–induced **deconditioning**
- Systemic inflammation
- Oxidative stress
- ↓ **Muscle mass**
- ↓ Capacity for **muscle aerobic metabolism**
- ↑ **Lactic acidosis** for a given work rate



Exercise Training

No changes in lung function

Improve

Skeletal muscle exercise capacity

Oxidative capacity

Efficiency of the skeletal muscles

→less alveolar ventilation for a given WR

→reduce dynamic hyperinflation

→reduce exertional dyspnea

Duration and Frequency

- **Longer** programs → more training effects
- At least **three times per week**
- Regular supervision of exercise sessions

Intensity of Exercise

- **High** vs Low intensity
- **> 60%** of the **peak exercise capacity**

  some physiologic training effects
- Symptom scores

  → Borg score : 4 to 6
- HR at the gas exchange threshold

Specificity of Exercise Training

- Many activities of daily living involve upper extremities.
- Limb exercises should also be incorporated into the training program
- Arm cycle ergometer, free weights, and elastic bands.

Endurance and strength training

- Endurance
- intensity (60% maximal work rate).
- **> 30 minutes**
- Strength
- two to four sets of 6 to 12 repetitions (50 to 85% of one repetition maximum)

Practice guidelines

1. A minimum of 20 sessions, three times per week
2. High-intensity exercise produces greater physiologic benefit

   low-intensity training is also effective
3. Both upper and lower extremity training should be utilized.
4. The combination of endurance and strength training generally has multiple beneficial effects

Self-Management Education

- Core component of comprehensive PR

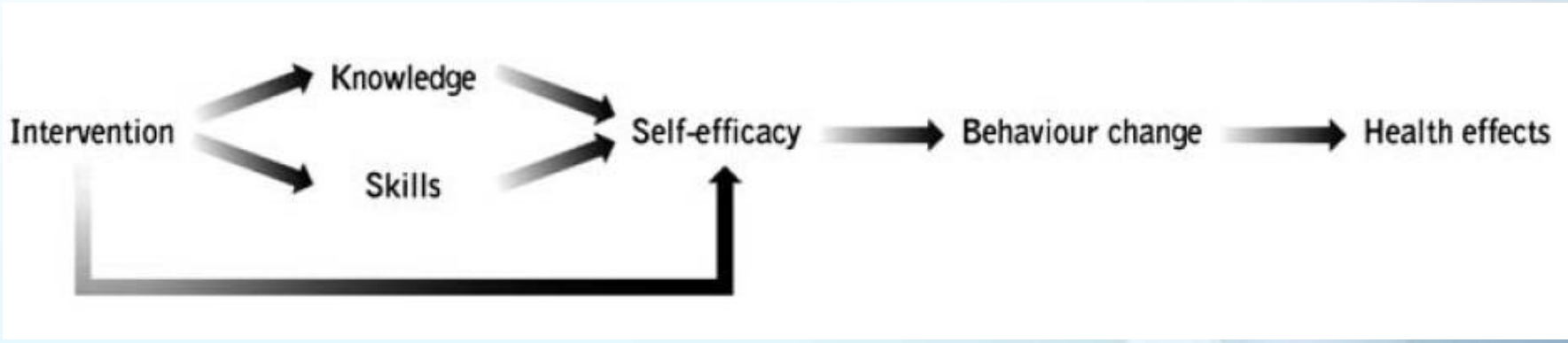


TABLE 3. EXAMPLES OF EDUCATIONAL TOPICS

Breathing Strategies
Normal Lung Function and Pathophysiology of Lung Disease
Proper Use of Medications, including Oxygen
Bronchial Hygiene Techniques
Benefits of Exercise and Maintaining Physical Activities
Energy Conservation and Work Simplification Techniques
Eating Right
Irritant Avoidance, including Smoking Cessation
Prevention and Early Treatment of Respiratory Exacerbations
Indications for Calling the Health Care Provider
Leisure, Travel, and Sexuality
Coping with Chronic Lung Disease and End-of-Life Planning
Anxiety and Panic Control, including Relaxation Techniques and Stress Management

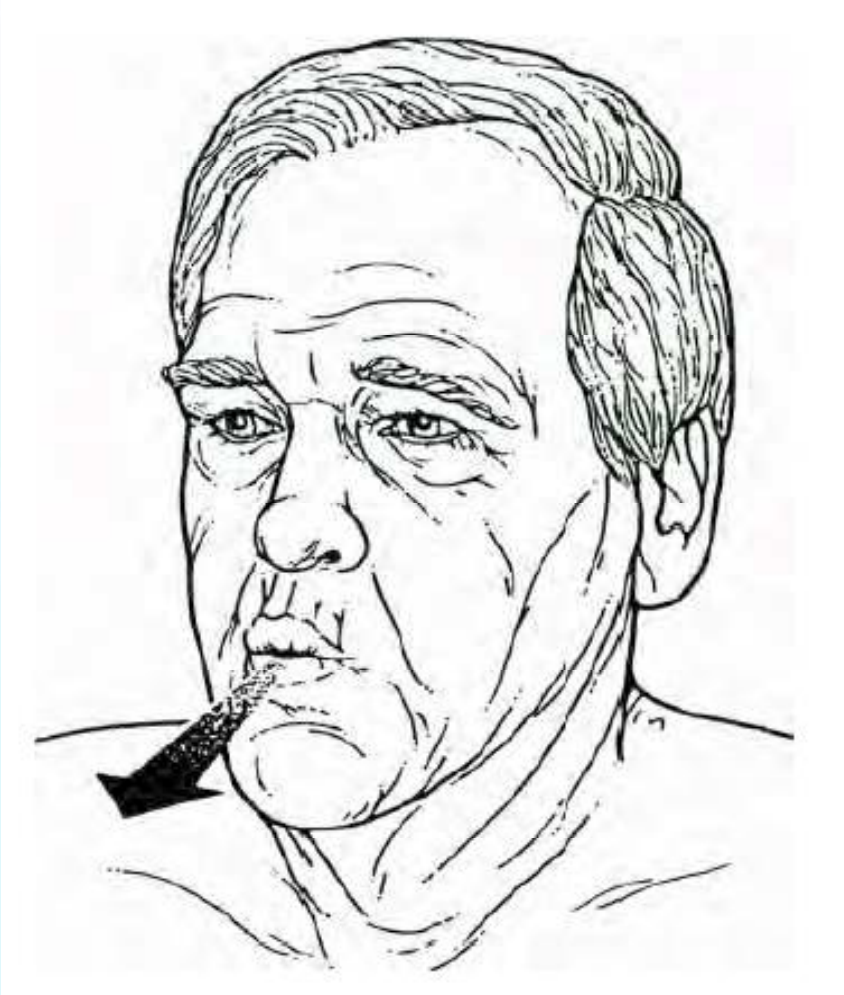
Education

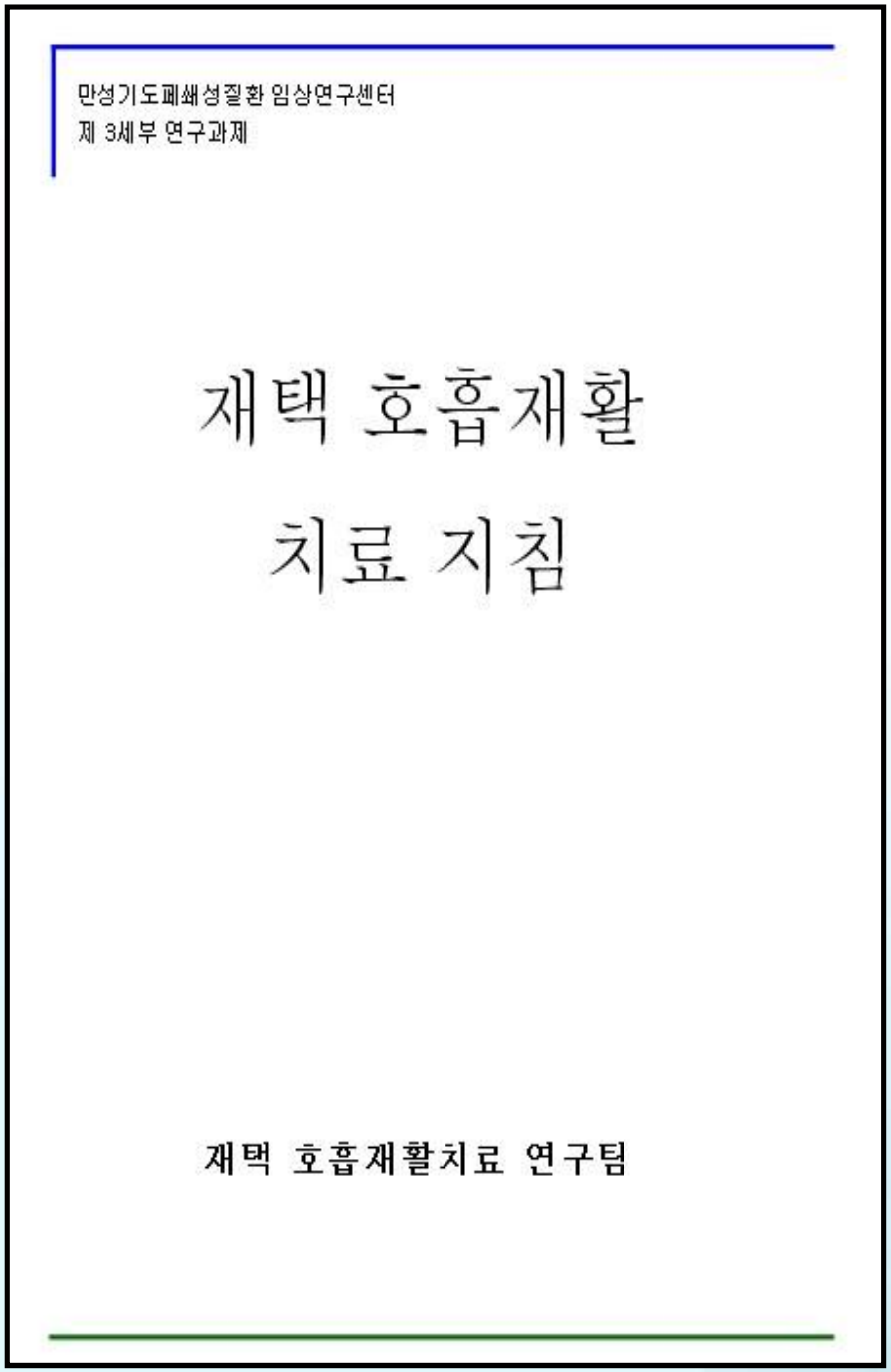
- Prevention and early treatment of exacerbations.
- End-of-life decision making.
- Breathing strategies.
- Bronchial hygiene techniques.

Breathing Strategies

- Pursed-lip breathing,
- Active expiration
- Diaphragmatic breathing
- Specific body positions
- Coordinating paced breathing with activities.

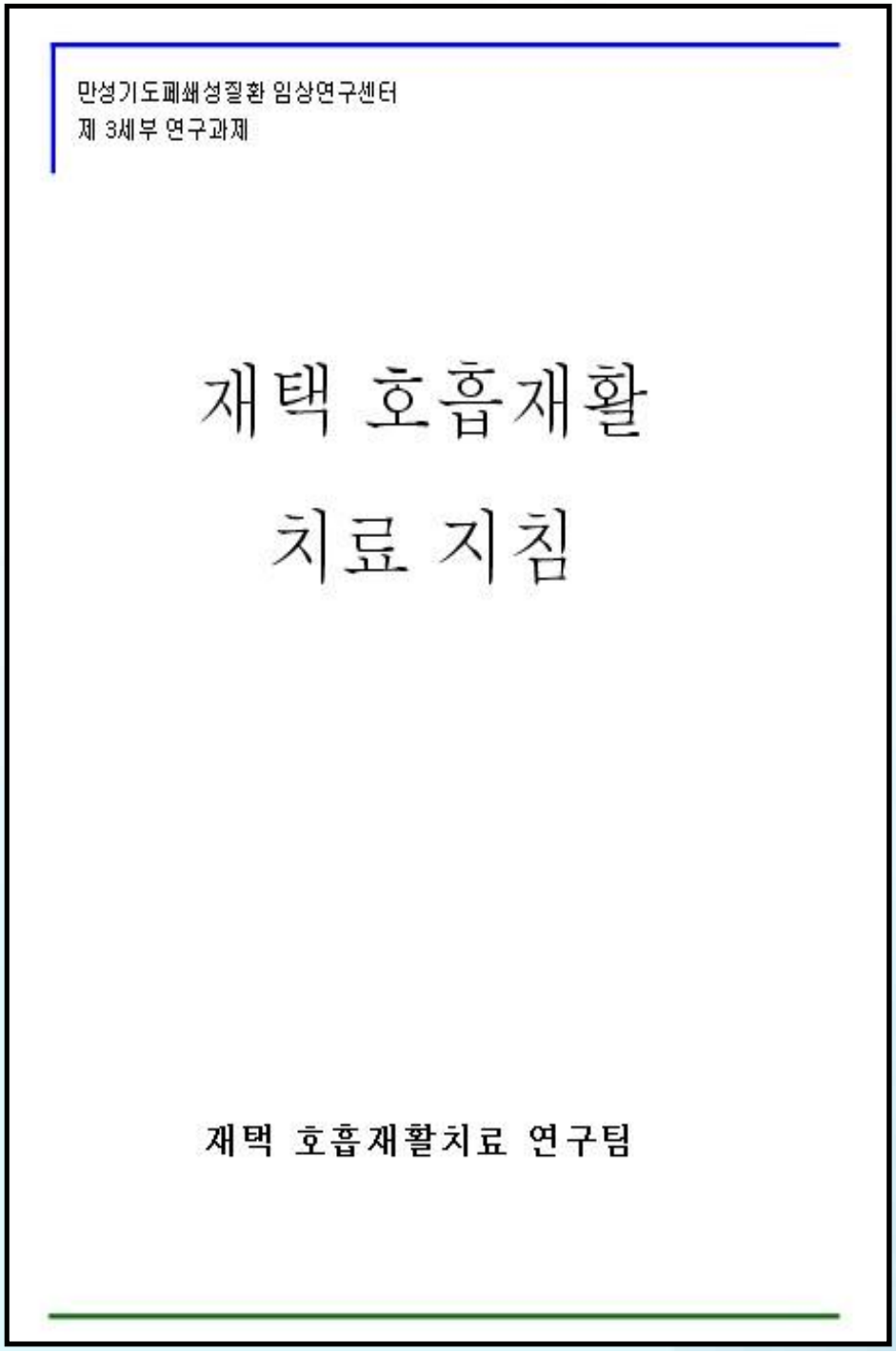
Pursed-lip breathing





I. 호흡재활치료

1. 정의 및 목표
2. 형태 및 현황
3. 효과
   1) 운동 수행 능력
   2) 삶의 질 (QOL)
   3) 비용절감효과
   4) 생존률
4. 치료 방법
   1) 운동 훈련
      (1) 운동훈련의 필요성
      (2) 운동 형태
         ① 유산소운동
         ② 근력강화운동
         ③ 호흡근 운동
   2) 교육
   3) 정신과적 보조
   4) 영양 보조

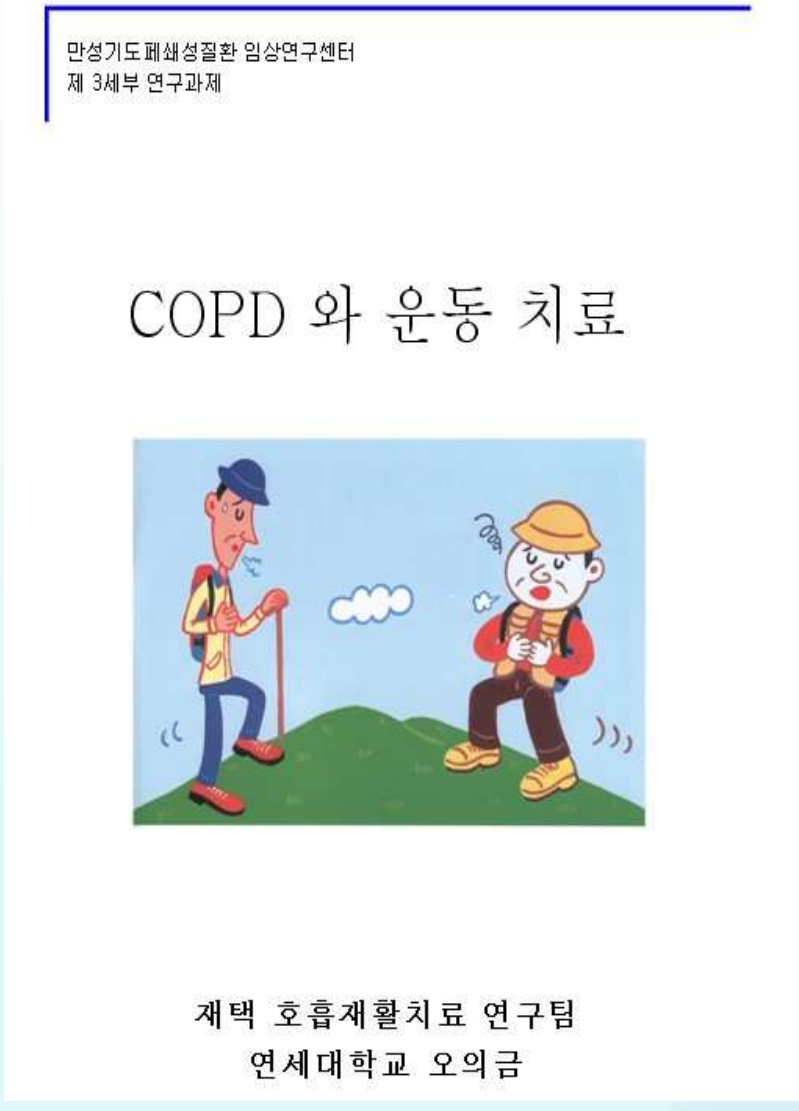


II. 재택 호흡재활치료 지침

1. 적응증, 금기증
2. 치료 전, 후 평가 방법
3. 교육:
    1) COPD의 정의
    2) 치료 방법
    3) 호흡 방법 (복식 호흡)
    4) 기도 관리, 체위 배농법
    5) 긴장 완화법
    6) 악화 시 대처 방법
    7) 에너지 절약법
    8) 예방법
4. 운동 치료
    1) 유산소 운동
    (1) 운동 방법
    (2) 강도
    (3) 지속시간, 빈도
    2) 근력 강화 운동
5. 정신과적 보조
6. 영양 보조

Education Material

만성기도폐쇄성질환
임상연구센터



환자 교육용 배부자료

1. 만성 폐쇄성 폐질환이란?
2. 호흡재활이란?
3. 숨이 찰때는 어떻게?
4. 기관지확장제 사용 방법
5. 호흡 방법
6. 운동 방법
7. 긴장 완화법
8. 영양관리
9. 일상생활에서의
   건강관리/에너지 보존

Current Status of PR in Korea

Monaldi Arch Chest Dis
2005; 63: 1, 30-36

ORIGINAL ARTICLE

A simple and easy home-based pulmonary rehabilitation programme for patients with Chronic Lung Diseases

Joo Ock Na[1], Dong Soon Kim[1], Seong Ho Yoon[1], Yang Jin Jegal[1], Woo Sung Kim[1], Eung Suk Kim[1], Myung Wha Kim[2]

Monaldi Arch Chest Dis 2005;63:30-36

Table 2. - Changes in the Parameters of Incremental Exercise Test

Variables	Rehabilitation Group		
	Baseline	12 weeks	*p* value
WR max (watts)	59.0 ± 25.8	65.0 ± 26.4	0.041
VO_2max (L/min)	0.85 ± 0.31	0.90 ± 0.31	0.027
AT (L/min)	0.74 ± 0.22	0.73.± 0.24	NS
O_2pulse (ml/beat)	7.64 ± 3.26	7.72 ± 3.17	NS
HR max (beats/min)	129.9 ± 19.5	131.6 ± 17.3	NS
V_E max (L/min)	36.6 ± 12.1	38.1 ± 11.1	NS
Dyspnoea (Borg scale)	8.78 ± 0.54	8.78 ± 0.78	NS

Monaldi Arch Chest Dis 2005;63:30-36

Table 3. - Changes in the Exercise Endurance, 6 Minute Walking

Variables	Rehabilitation Group		
	Baseline	12 weeks	*p* value
Lower extremity			
Duration (min)	8.2 ± 3.5	14.0 ± 4.5	0.001
Work (Watts)	41.5 ± 17.5	46.5 ± 19.0	0.005
Upper extremity			
Duration (min)	5.9 ± 3.2	6.8 ± 3.4	0.001
Work (Watts)	16.2 ± 8.0	19.7 ± 8.5	0.001
6 min walk(m)	470.7 ± 63.2	508.4 ± 61.1	0.001
Mean SaO_2*	89.9 ± 5.50	88.5 ± 5.94	NS
Min SaO_2**	86.1 ± 7.12	83.8 ± 7.66	NS
MIP (cm H_2O)	80.0 ± 29.5	103.5 ± 35.2	0.001

Monaldi Arch Chest Dis 2005;63:30-36

The Effect of Pulmonary Rehabilitation in Patients with Chronic Lung Disease

Kang Hyeon Choe, Young Joo Park ,Won Kyung Cho, Chae Man Lim
Sang Do Lee, Youn suck Koh, Woo Sung Kim, Dong Soon Kim, Won Dong Kim

Department of Internal Medicine, Asan Medical Center, College of Medicine, University of Ulsan

Tuberc Respir Dis 1996;43:736-745

= Abstract =

Development of the Home-Based Pulmonary Rehabilitation Program for Patients with Chronic Lung Disease

Seong Ho Yoon, Joo Ok Na, Yangjin Jegal, Myung Wha Kim*,
Eung Suk Kim*, Tae Sun Shim, Chae Man Lim, Sang-Do Lee,
Younsuck Koh, Woo Sung Kim, Won Dong Kim, Dong Soon Kim

Division of Pulmonary and Critical Medicine, Department of Internal Medicine
*and Health Promotion Center**
Asan Medical Center, Univ. of Ulsan College of Medicine, Seoul, Korea

Tuberc Respir Dis 2002;52:597-607

Location of PR

1) Inpatient PR
2) Out-patient based PR
3) Home-based PR

Home-based PR

- Indication :

Stable COPD without execerbation within 3 months

- PR program :

  12 weeks, Home-based exercise training

  Visit sport medicine clinic ; every 2 weeks

  Education, Self management

- Outcome

  Exercise capacity, QOL

Home-based PR

- PR program

  1) Endurance exercise (Walk)
  2) Strength training
  3) Respiratory muscle training
  4) Patient education
  5) Nutritional counselling
  6) Psycosocial counselling

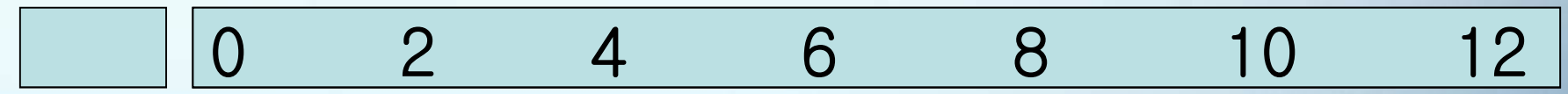
Assessment

Spirometry, Lung volume, DLCO

6 min walking test, Exercise PFT

SGRQ, IPAQ

Chest X-ray, Lab.



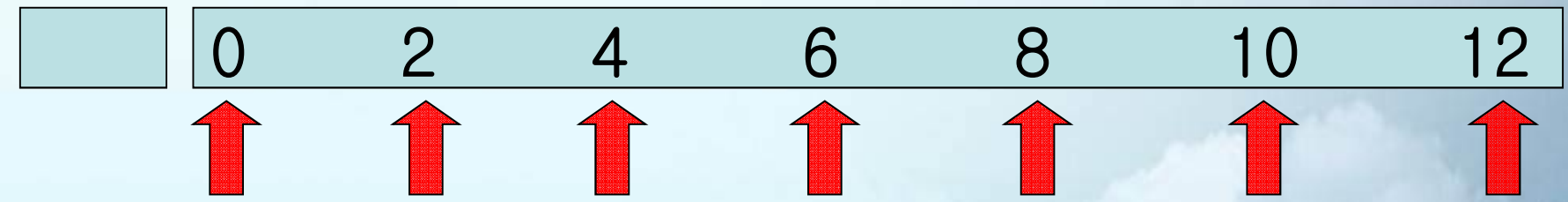
Assessment

Spirometry, Lung volume, DLCO

6 min walking test , Exercise PFT

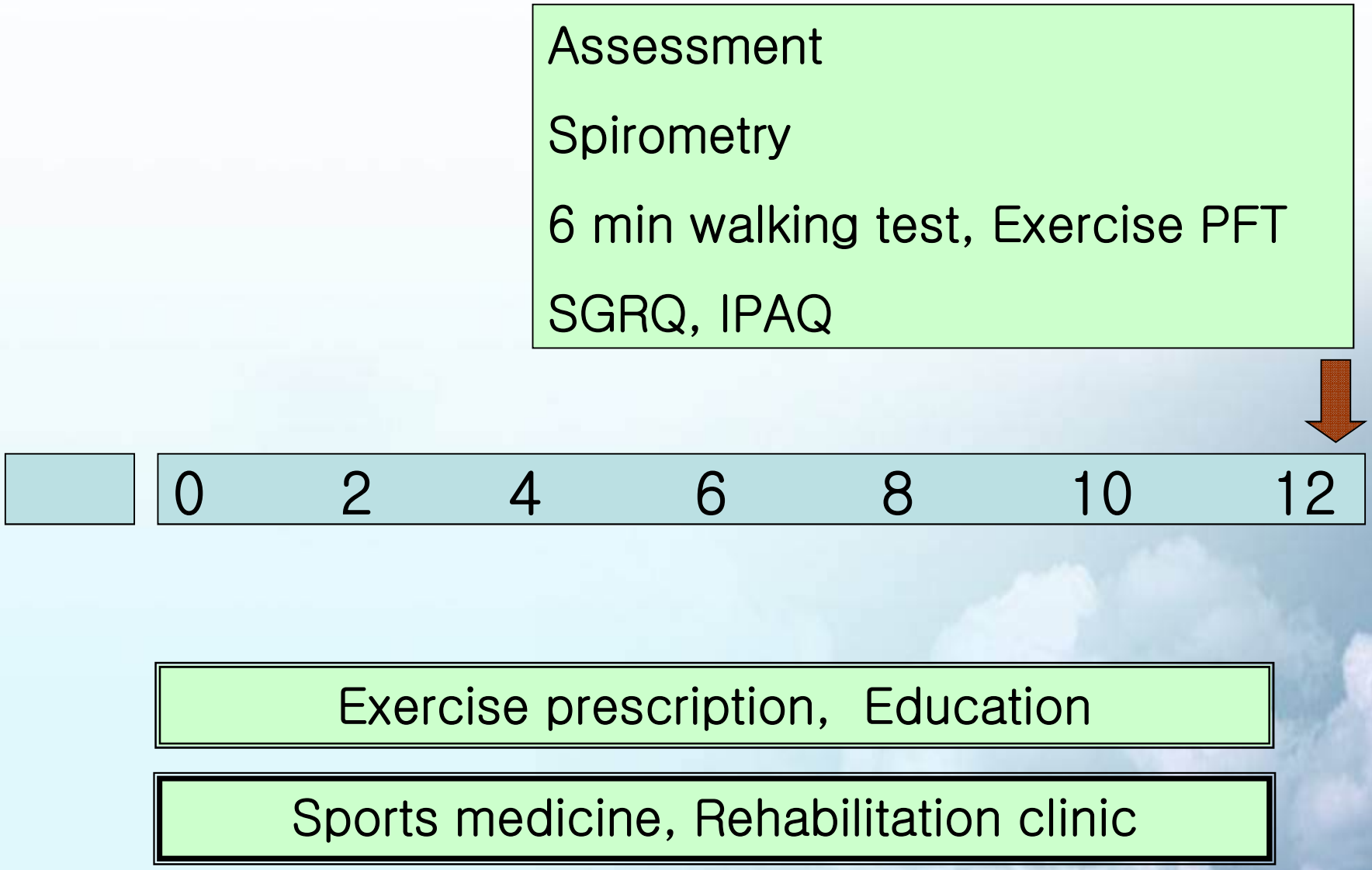
SGRQ, IPAQ

Chest X-ray, Lab.



Exercise prescription, Education

Sports medicine, Rehabilitation clinic


Assessment
Spirometry
6 min walking test, Exercise PFT
SGRQ, IPAQ
0
2
4
6
8
10
12
Exercise prescription, Education
Sports medicine, Rehabilitation clinic

VO2 max

운동 처방

- VO_2 max : 결정 21 ml/kg/min
- METs : VO_2max/3.5 6 METs

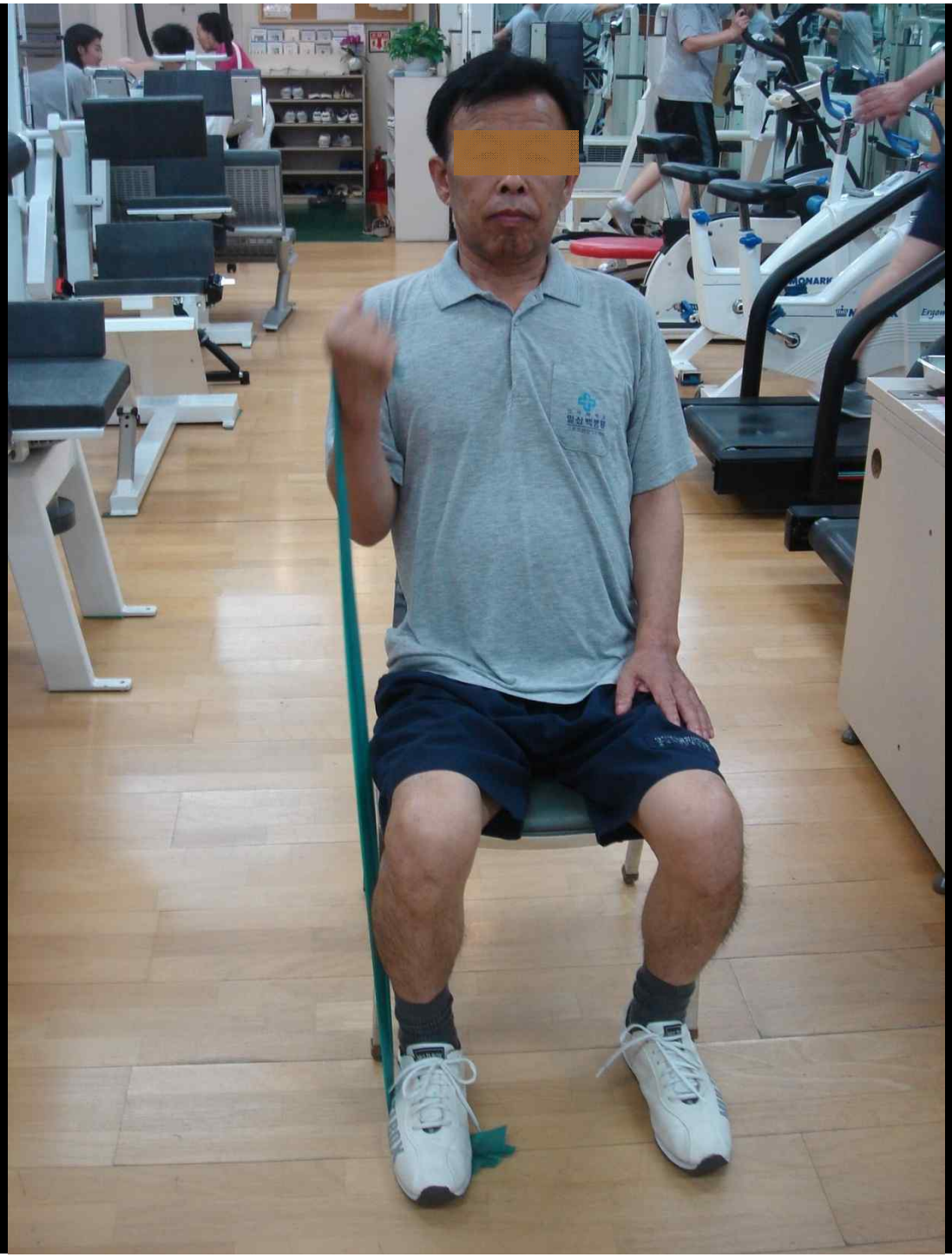
표 3. Treadmilll 걷기 속도 설정표

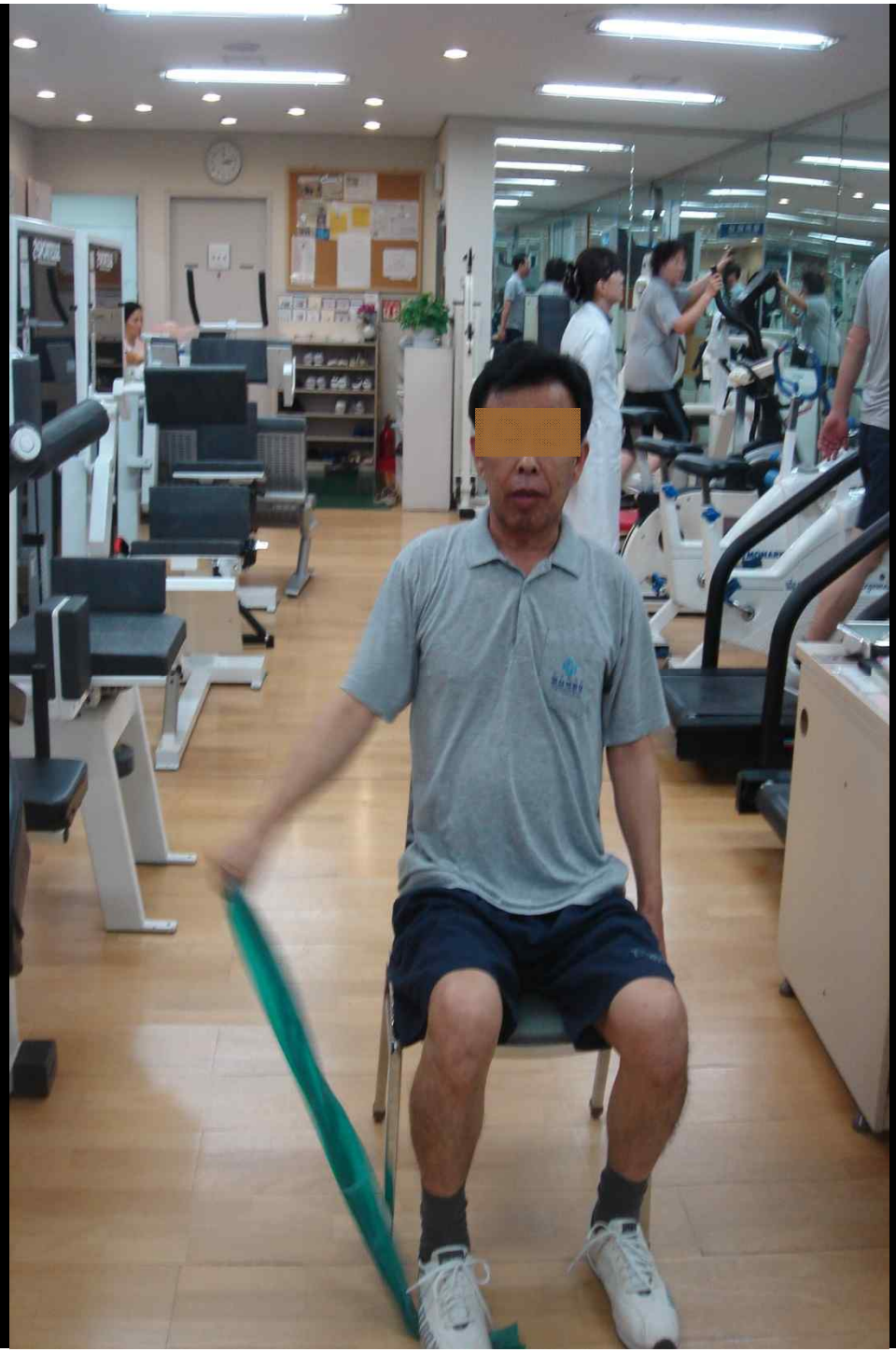
등급	최대 METs	속도(Km/h)	100m 당 걸리는 시간
1	3.4 이하	1.6	3' 45"
2	3.5-4.4	2.9	2' 4"
3	4.5-5.4	4.2	1' 25"
4	5.5-6.4	5.4	1' 7"
5	6.5 이상	6.4	56"

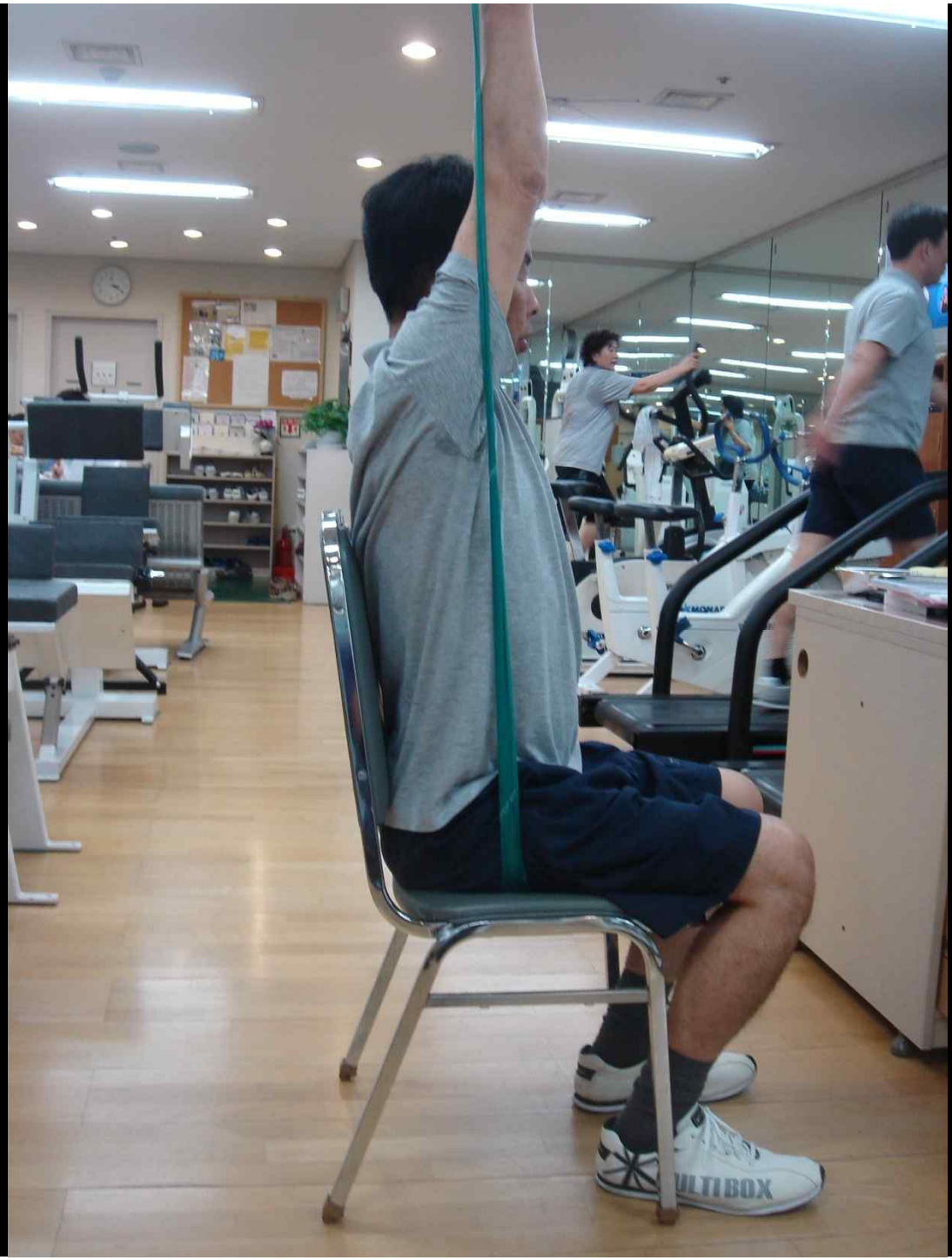
BEAT RHYTHM ON/OFF
Muztek
Digital Metronome

걷기 운동프로그램			
단계	일회 운동시간(분)	하루 운동 횟수	일주당 운동 횟수
1	2.5	10	5
2	5	6	5
3	7.5	4	5
4	10	3	5
5	12.5	3	5
6	15	2	5
7	20	2	5
8	25	2	5
9	30	1	5
10	35	1	5
11	40	1	5
12	45	1	5

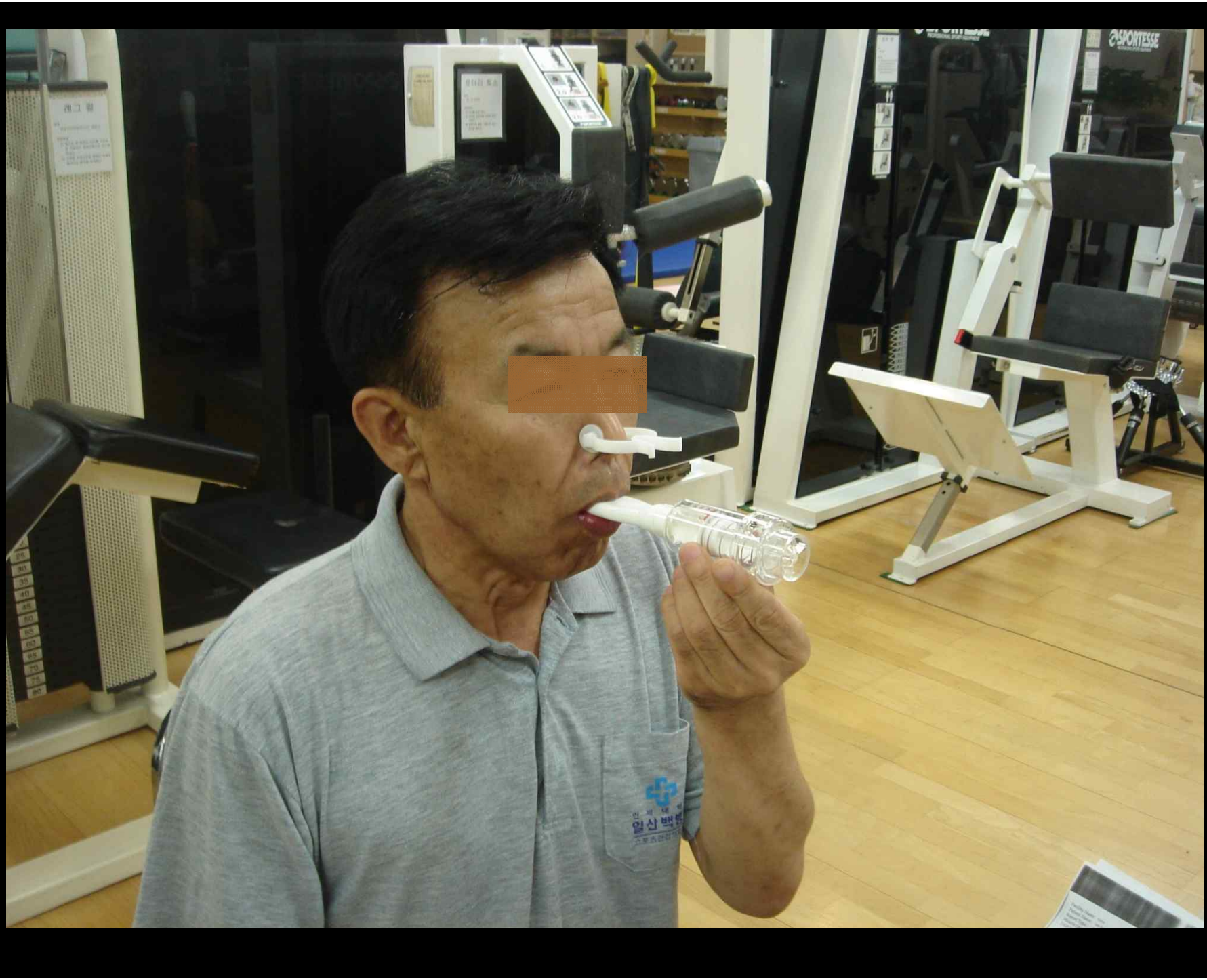
Muscle Strength Exercise






ULTIBOX

Respiratoy Muscle Exercise


SPORTESSE

COPD환자에서 6분 보행검사를 이용한 최대산소섭취량 예측

한림대학교 의과대학 [1]내과학교실 및 [2]폐연구소, [3]재활의학교실, 인제대학교 의과대학 [4]내과학교실, [5]가정의학과교실, [6]스포츠건강의학센터, 울산대학교 의과대학 [7]내과학교실, [8]스포츠건강의학센터, [9]이화여자대학교 의과대학 내과학교실

김창환[1], 박용범[1,2], 모은경[1], 최은희[3], 남희승[3], 이성순[4], 유영원[4], 양윤준[5], 문정화[6], 김동순[7], 이향이[7], 진영수[8], 이혜영[8], 천은미[9]

Predicting Oxygen Uptake for Men with Moderate to Severe Chronic Obstructive Pulmonary Disease

Changhwan Kim, M.D.[1], Yong Bum Park, M.D.[1,2], Eun Kyung Mo, M.D.[1], Eun Hee Choi, M.D.[3], Hee Seung Nam, M.D.[3], Sung-Soon Lee, M.D.[4], Young Won Yoo[4], Yun Jun Yang, M.D.[5], Joung Wha Moon[6], Dong Soon Kim, M.D.[7], Hyang Yi Lee[7], Young Soo Jin, M.D.[8], Hye Young Lee[8], Eun Mi Chun, M.D.[9]

Departments of [1]Internal Medicine, [2]Lung Research Institute, [3]Rehabilitation Medicine, Hallym University College of Medicine; Departments of [4]Internal Medicine, [5]Family Medicine, [6]Sports Medicine Center, Inje University College of Medicine; [7]Department of Internal Medicine, [8]Sports Medical Center, Asan Medical Center, Ulsan University College of Medicine; [9]Department of Internal Medicine, Ewha University College of Medicine, Seoul, Korea

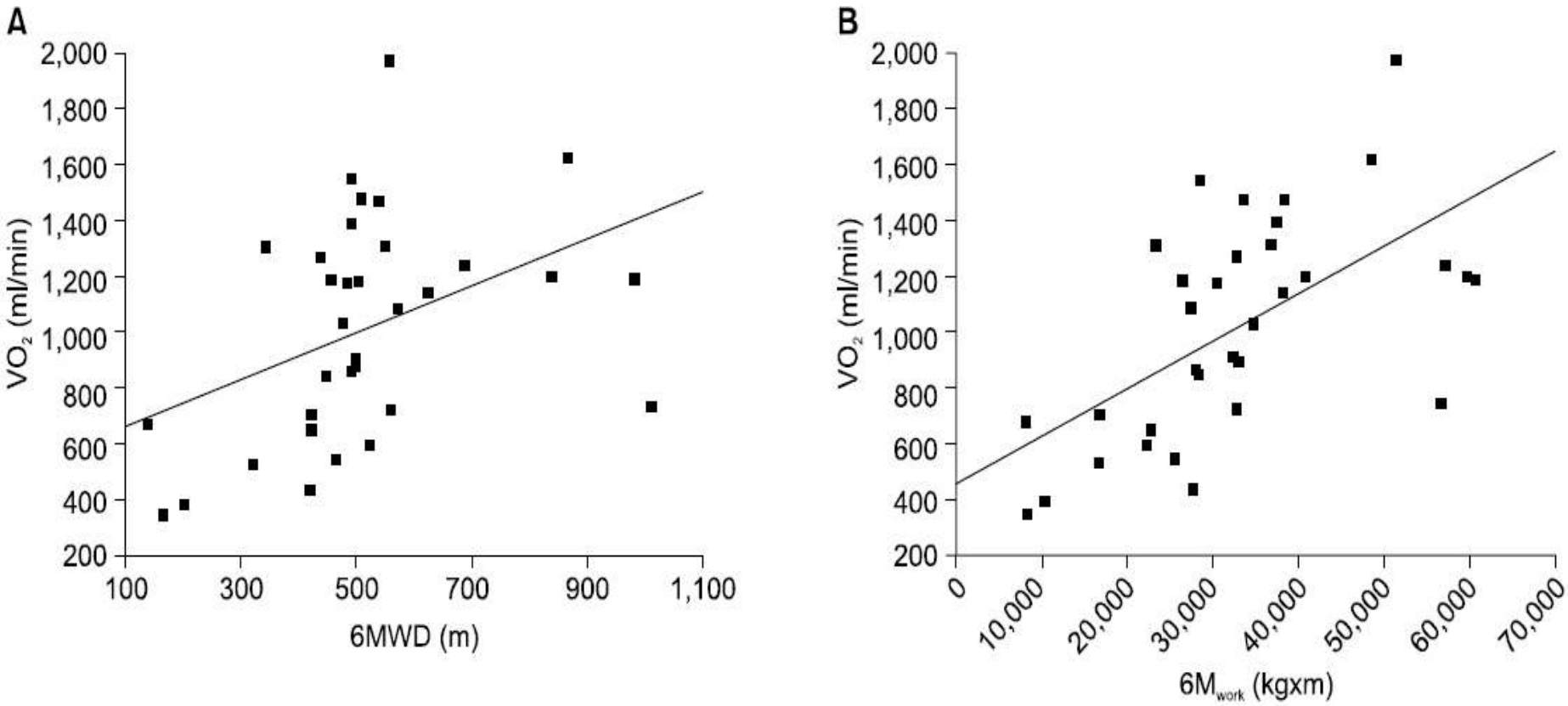


Figure 1. Index of work ($6M_{work}$) was better correlated to peak oxygen uptake (VO_2) than 6-minute work distance (6MWD). Scatterplot of peak VO_2 to 6MWD ($r=0.415$, $p=0.016$) (A). Scatterplot of peak VO_2 to $6M_{work}$ ($r=0.597$, $p<0.001$) (B).

Result

- Total number : n = 20 male patients
- FVC : 2.93±0.91, (80.9±23.1%)
- FEV1 : 1.41±0.52, (60.7±20.6%)
- FEV1/FVC : 52.4±15.2 %

- VO_2max : 13.9 ± 3.8 → 15.0 ± 3.7 l/kg/min
- VO_2max : 65.0±15.6%
- 6 MWD : 387 m ± 37 → 480 ± 51 m

Result

- SGRQ score
- Total : 44.5 ±15.1
- Symtom : 44.1±15.0
- Activity : 70.4 ±19.3
- Impact : 29.9 ±19.7
- IPAQ
- Low : 13

  Moderate : 7

Step Test, Shuttle walking

- **Safe, Easy**

  Predict VO_2max

  Replace the Exercise CPX

  Apply to the general population

- Modified YMCA 3 min Step Test

Step Test, Shuttle walking

- Safe, Easy

  Predict VO_2max

  Replace the Exercise CPX

  Apply to the general population

- Modified YMCA 3 min Step Test

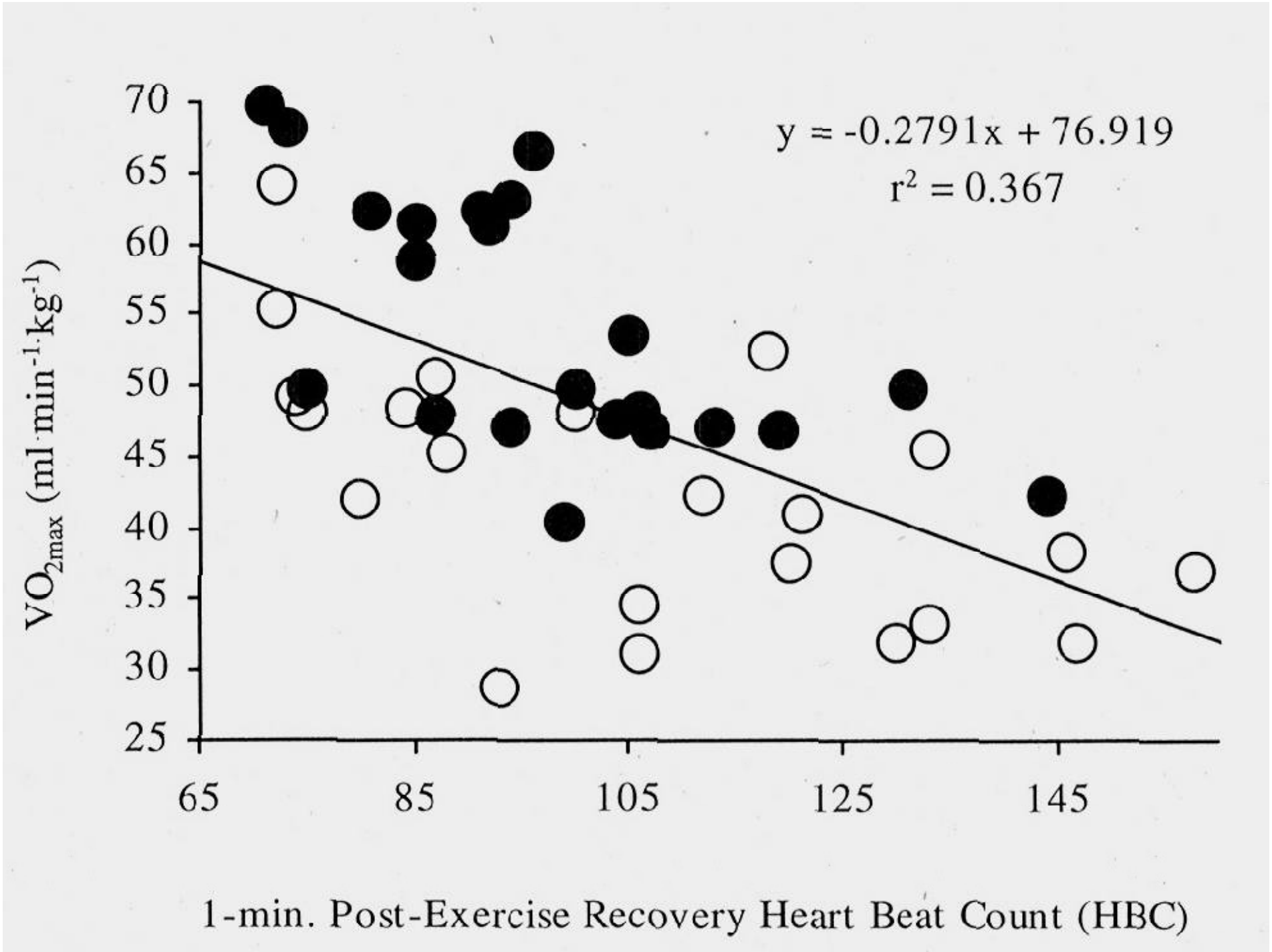

y = -0.2791x + 76.919
r² = 0.367
VO2max (ml·min-1·kg-1)
70
65
60
55
50
45
40
35
30
25
65
85
105
125
145
1-min. Post-Exercise Recovery Heart Beat Count (HBC)

Table 3. Prediction equations for VO_2max from 15-s and 1-min HBCs

Group	15-s HBC	1-min HBC
All (*N* = 44)	y = -0.9675x + 77.643	y = -0.2805x + 76.710
Women (*n* =22)	y = -0.7764x + 67.344	y = -0.2021x + 64.209
Men (*n* =22)	y = -1.1114x + 87.130	y = -0.3143x + 84.841

Note. HBC = post exercise recovery heart beat counts; VO_2max = measured maximal oxygen consumption; All = females + males; x = HBC; y = predicted VO_2max.

PR Insurance Coverage

- 호흡재활치료 보험 산정기준
- 유발성흡기폐활량계 – 호흡운동
- 체위배액치료
- 호흡재활치료
- 30분 이상 실시한 경우
- 6,110원입니다.

Incentive Spirometry

고빈도흉벽진동요법

이학요법료 **3,050**원/일

High frequency oscillation chest physiotherapy

재택 호흡재활 프로그램

- 비급여 운동, 교육 프로그램
- 서울 아산병원 : 12주, 6회, 14만원
- 일산 백병원 : 12주, 7회, 11 만원