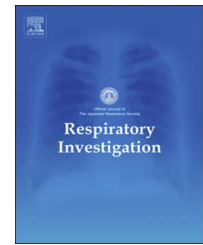




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## Review

# Improvement of physical activity in chronic obstructive pulmonary disease by pulmonary rehabilitation and pharmacological treatment

Takanobu Shioya<sup>a,\*</sup>, Susumu Sato<sup>b</sup>, Masahiro Iwakura<sup>a,c</sup>, Hitomi Takahashi<sup>c</sup>,  
Yoshino Terui<sup>a</sup>, Sachiko Uemura<sup>a</sup>, Masahiro Satake<sup>a</sup>

<sup>a</sup>Akita University Graduate School of Health Sciences, Department of Physical Therapy, Akita, Japan

<sup>b</sup>Kyoto University Hospital, Department of Rehabilitation & Pulmonary Medicine, Kyoto, Japan

<sup>c</sup>Akita City General Hospital, Department of Rehabilitation, Akita, Japan

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## ABSTRACT

Physical activity (PA) is defined as bodily movement produced by skeletal muscles with energy expenditure beyond resting levels. PA is closely related to reduced morbidity and mortality in chronic obstructive pulmonary disease (COPD). Self-report questionnaires are often subject to recall bias, correlating poorly with objectively qualified PA, and do not provide an accurate estimate of free-living energy expenditure. PA may be objectively evaluated by newly developed tri-axial accelerometers by quantifying steps or body movements over a period of time. Low-intensity, home-based pulmonary rehabilitation (PR) using pedometer feedback improves PA. Improvement in physiological factors correlates with increased walking time in stable elderly COPD patients.

This review focuses on the effects of PR and pharmacological treatment on PA in COPD patients. We selected 32 studies from our literature search evaluating the effects of PR and 11 studies examining the effects of pharmacological treatment on PA. Findings in both categories were inconsistent. Nineteen studies showed a positive effect with PR whereas 13 showed no effect. Eight studies showed a positive effect, while three revealed no effect from pharmacological intervention. As both interventions increase exercise capacity without a consistent effect on PA, counseling with behavioral changes may be necessary to achieve a significant and lasting increase in PA. Changing PA behavior in COPD patients requires an interdisciplinary approach involving specialists in respiratory medicine, rehabilitation, social, and behavioral sciences. Future research in this area is warranted to advance our knowledge in this area, specifically with regard to the interaction of pharmacological and non-pharmacological interventions.

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\*Correspondence to: Department of Physical Therapy, Akita University Graduate School of Health Sciences Hondo, Akita City, Akita 010-8543, Japan. Fax: +81 18 884 6500.

E-mail addresses: [shioya@hos.akita-u.ac.jp](mailto:shioya@hos.akita-u.ac.jp) (T. Shioya), [ssato@kuhp.kyoto-u.ac.jp](mailto:ssato@kuhp.kyoto-u.ac.jp) (S. Sato), [m.iwa.phys.ther@gmail.com](mailto:m.iwa.phys.ther@gmail.com) (M. Iwakura), [ac830887@akita-city-hospital.jp](mailto:ac830887@akita-city-hospital.jp) (H. Takahashi), [terui@hs.akita-u.ac.jp](mailto:terui@hs.akita-u.ac.jp) (Y. Terui), [uemura@hs.akita-u.ac.jp](mailto:uemura@hs.akita-u.ac.jp) (S. Uemura), [satake@hs.akita-u.ac.jp](mailto:satake@hs.akita-u.ac.jp) (M. Satake).

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## 1. Introduction

Chronic obstructive pulmonary disease (COPD) is characterized by progressive airflow limitation that is not fully reversible, leading to adverse respiratory effects and systemic sequelae [1,2]. Optimal clinical management of COPD generally requires both pharmacological and non-pharmacological treatment [1,2]. Pulmonary rehabilitation (PR) by definition involves an integrated, interdisciplinary approach as a basic non-pharmacological treatment [1,2]. On the basis of current insights, the American Thoracic Society (ATS) and the European Respiratory Society (ERS) have adopted a new definition of PR as a “comprehensive intervention based on a thorough patient assessment followed by patient-tailored therapies that include, but are not limited to, exercise training, education, and behavior change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviors” [3]. Currently, COPD is understood to be a complex disease, with multi-system manifestations and frequent comorbidities; thus, integrated care principles must be adopted to optimize management [3,4].

Physical inactivity appears to be more common in patients with COPD than in age-matched healthy individuals and patients with other chronic diseases, such as coronary artery disease and rheumatoid arthritis [3,5]. Physical inactivity independently predicts poor outcomes across several aspects of this disease [6,7]. Furthermore, physical activity (PA) decreases substantially over time in patients with COPD, to a greater extent than in non-COPD subjects [3,8].

This clinical review will first cover the definition of PA, its prevalence and significance in COPD, and methods of objective measurement. We will also review the risk factors for physical inactivity and potential ways to improve or maintain one or more components of physical fitness. PR has the greatest positive effect of any current therapy on exercise capacity in COPD [3,9]. PR also emphasizes behavior change through collaborative self-management. Certain types of PR may aid in the translation of increased exercise capacity to greater participation in PA; however, this may not always occur. Accordingly, the second part of this review will focus on the previously reported effects of different protocols of PR and pharmacological treatment on PA [3,4,9]. We searched PubMed from 2000 to 2017 for original articles written in

English. The following terms were used to search for articles related to pharmacological and non-pharmacological treatment for PA in COPD: physical activity, physical inactivity, sedentary, steps, accelerometer, pedometer, motion sensor, calorimeter. A total of 430 articles were identified. After evaluation, 32 articles that addressed non-pharmacological treatment and 11 articles that addressed pharmacological treatment in COPD were selected for this review. The third part of this review will focus on the importance of counseling with feedback and behavior change, and increasing self-efficacy in future approaches to PA.

## 2. Physical activity

PA can be defined as “any bodily movement produced by skeletal muscles that results in energy expenditure” [8,9]. Therefore, PA in daily life can be considered as “the total voluntary movement produced by skeletal muscles during everyday functioning” [10,11] and is assessed by the quantification of these total movements during daily life. By contrast, exercise is “a subset of PA that is planned, structured, repetitive and purposeful” [3,8] and uses different assessment methods, such as maximal and submaximal exercise tests [12,13]. PA is a complex behavior influenced by a combination of individual, sociocultural, and environmental factors [9]. It can be characterized by type, intensity, duration, patterns, routines, and activity-related symptoms [14]. Types of PA include leisure time, domestic, and occupational activities, but are not limited to these factors [15]. “Activities of daily living” refer to a subset of PA that encompasses basic, everyday tasks required for personal self-care and independent living [15,16]. There are specific methods to assess the performance of activities of daily living such as specific ADL questionnaires and functional tests [17,18].

## 3. Evaluation of physical activity

Questionnaires and motion sensors are the most common assessment methods used to quantify PA in patients with COPD [3,4,19]. Despite their widespread use, questionnaires are prone to inaccuracy when used on an individual level [9,20]. Daily PA can be measured accurately and expressed as

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