Minimal clinically important difference for daily pedometer step count in COPD

To the Editor:

Assessment of physical activity is an important part of COPD management, because physical inactivity is associated with mortality and morbidity in this disease group [1]. The most commonly used physical activity outcome is daily step count, typically measured using an accelerometer or pedometer [2]. Outside the research arena, pedometers are used more commonly than accelerometers due to lower cost, simplicity and acceptability to patients. Although previous studies have described the minimal clinically important difference (MCID) in accelerometer daily step count, these estimates are not appropriate for the interpretation of meaningful changes in pedometer step count, as pedometers are less reliable in capturing daily step count [3]. The MCID for improvement in daily pedometer step count in patients with COPD undergoing pulmonary rehabilitation is not known, and there are limited data on MCID for deterioration in pedometer step count. The aim of our study was to provide an estimate of the MCID for daily pedometer step count in patients with COPD, using response to pulmonary rehabilitation as a model of improvement and longitudinal decline following pulmonary rehabilitation as a model of deterioration.

This was a secondary analysis of a randomised controlled trial that investigated the effectiveness of pedometer-directed step count targets as an adjunct to pulmonary rehabilitation in improving physical activity in COPD [4]. The original trial protocol was registered on clinicaltrials.gov (NCT01719822) and granted ethical approval by the West London Research Ethics Committee (11/LO/1021). For this data analysis we combined the two study arms, as the intervention of the primary study did not result in any significant between-group differences [5].

We included people with COPD referred to an 8-week outpatient pulmonary rehabilitation programme at Harefield Pulmonary Rehabilitation Unit. The programme adhered to British Thoracic Society quality standards for pulmonary rehabilitation [6] and has been described elsewhere [4, 7]. We measured spirometry, Medical Research Council (MRC) dyspnoea score, incremental shuttle walk (ISW) test, Chronic Respiratory Questionnaire (CRQ) and pedometer step count (Yamax Digiwalker CW700; Yamax, Bridgnorth, UK) pre-, post- and 6 months following pulmonary rehabilitation. Patients wore the pedometer during waking hours for seven consecutive days following each assessment. At the end of the 7-day period, the step count for each day was retrieved from the device and the average was calculated. At the immediate post-pulmonary rehabilitation and 6 months post-pulmonary rehabilitation assessments, participants completed a Global Rating of Change Questionnaire (GRCQ) [8]: "How do you feel your physical activity levels have changed following rehabilitation?" and rated their response on a five-point Likert scale that ranged from "1: I feel much more active" to "5: I feel much less active".

Baseline data were reported using descriptive statistics. We compared outcomes using paired t-test (or Wilcoxon signed rank test for nonparametric data) and Chi-squared test for trend. We calculated the median (interquartile range (IQR)) change in pedometer step count for each GRCQ response. The MCID for improvement was defined as the value for "2: I feel a little more active" at the post-pulmonary rehabilitation assessment. The MCID for deterioration was the value for "4: I feel a little less active" at the 6-month assessment (compared to post-pulmonary rehabilitation).

@ERSpublications
Pedometer step count improves with pulmonary rehabilitation and deteriorates with time. The MCID for improvement and deterioration is 427 and −456 steps, respectively, but there is uncertainty about the reliability of these estimates. https://bit.ly/3ci97Jh

A total of 152 participants were enrolled in pulmonary rehabilitation, of which 113 (74%) and 98 (64%) attended the post-pulmonary rehabilitation and 6-month assessments, respectively. Baseline characteristics are as follows: male 72%; mean±SD age 68±9 years; forced expiratory volume in 1 s 50.5±21.2% predicted; MRC 3±1; ISW 259±145 m; CRQ total score 76.8±22.8; and median (IQR) daily pedometer step count 2418 (1440–4261) steps. Following pulmonary rehabilitation, there were significant improvements in mean (95% CI) change in MRC dyspnoea score (−1, −1–0), ISW (63, 51–75), CRQ total score (14.7, 11.8–17.6) and daily pedometer step count median (IQR) change (420 (−259–1582); p=0.03). 100 (88%) patients reported feeling "a little more active" or "much more active". Compared to the post-pulmonary rehabilitation assessment, there was a significant worsening in all outcomes at the 6-month assessment: mean (95% CI) change MRC dyspnoea 0.3 (0.1–0.5), ISW −32 (−46–−19), CRQ total score −6.7 (−9.6–−3.9) and median (IQR) change daily pedometer step count −262 (−1764–511) (p=0.04). 36 (37%) patients reported feeling "a little less active" or "much less active".

Due to the small number of participants (n=13), responses 3–5 ("I feel the same/less/much less active") were combined for the post-pulmonary rehabilitation GRCQ. The median (IQR) MCID estimate for improvement and deterioration in daily pedometer step count was 427 (−443–1286) and −456 (−2271–650) steps, respectively (figure 1). We did not combine the GRCQ data collected at the 6-month assessment.

This study demonstrates that pedometer-measured daily step count improves with pulmonary rehabilitation and deteriorates with time following programme completion. We estimated the MCID for improvement and deterioration in daily pedometer step count to be median (IQR) 427 (−443–1286) and −456 (−2271–650) steps, respectively. However, owing to the wide interquartile range there is uncertainty about the reliability of these estimates.
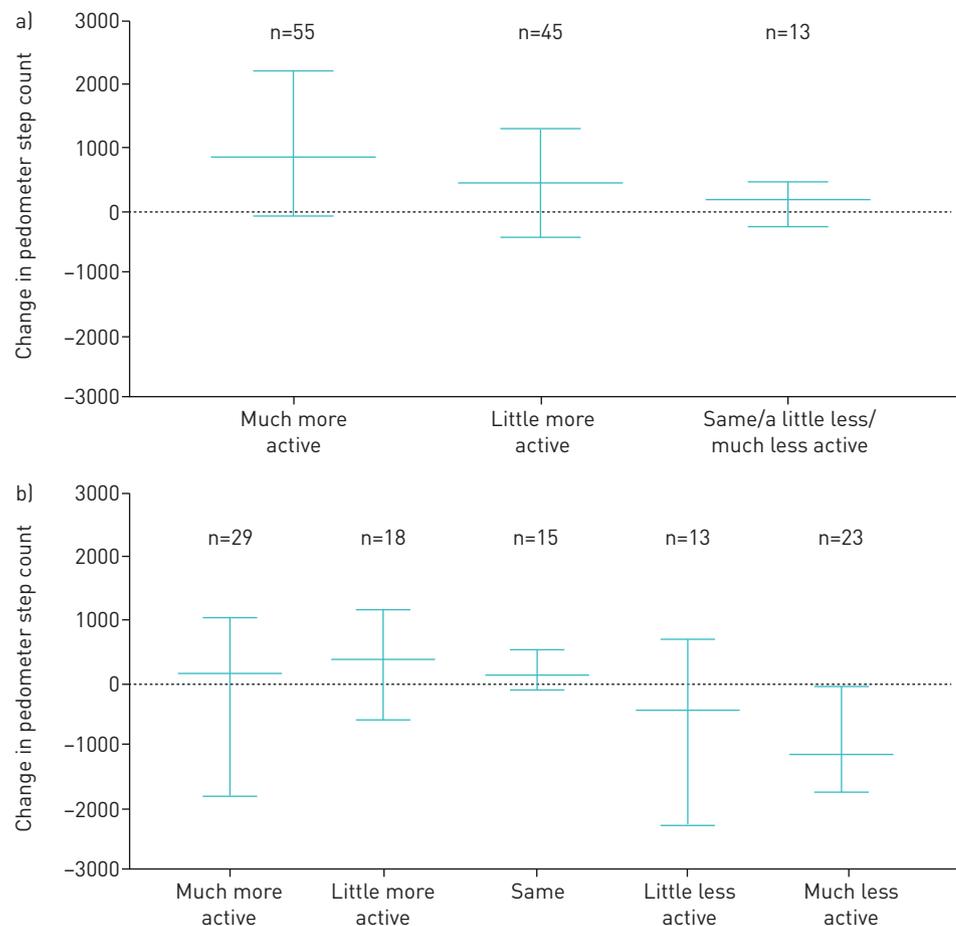

FIGURE 1 Median (interquartile range) change in step count according to the question: "How do you feel your physical activity levels have changed following rehabilitation?" at the a) post-pulmonary rehabilitation and b) 6-month assessments.

Only one study has estimated the MCID of daily pedometer step count. Using anchor-based methods, TEYLAN *et al.* [9] estimated that the MCID of deterioration in daily pedometer step count (Omron HJ-720ITC; Omron Healthcare, IL, USA) ranged between −350 and −1100 steps in 93 patients with COPD. Our mean estimate lies within this range, albeit at the lower end. We speculate that the higher MCID estimate reported by TEYLAN *et al.* is related to the choice of anchor. Whereas we used patient-reported anchors ("little more active" or "little less active"), TEYLAN *et al.* used the onset of a "clinically significant medical event" including emergency room treatment or hospitalisation. Using validated accelerometers and distribution-based methods, DEMEYER *et al.* [10] estimated the MCID of daily accelerometer step count to be 600–1000 steps. Although this is higher than our estimate, it is recognised that accelerometers are more reliable in capturing daily step count than pedometers [3].

A weakness of our study was that there was significant heterogeneity in daily pedometer step count change data, which was not normally distributed. There was a lack of correlation between the change in daily step count and change in exercise capacity (ISW), health-related quality of life (CRQ total score) and respiratory disability (MRC), limiting potential anchors. Although there is no gold standard technique or consensus on method of determining the MCID [11], our study used global rating of change responses which is a well-established anchor-based method for determining MCID [12, 13].

In summary, pedometer daily step count improves with pulmonary rehabilitation and deteriorates with time following programme completion in patients with COPD. The MCID estimates for improvement with pulmonary rehabilitation and deterioration over time after pulmonary rehabilitation are 427 and −456 steps, respectively, but there is uncertainty on the reliability of these estimates owing to the wide interquartile range. This should be evaluated in future studies.

Oliver Polgar [1], **Suhani Patel** [1], **Jessica A. Walsh** [1], **Ruth E. Barker** [1,2], **Stuart F. Clarke** [3], **William D-C. Man** [1,2,3,4] and **Claire M. Nolan** [1,2]

[1]Harefield Respiratory Research Group, Royal Brompton and Harefield Hospitals, Guy's and St Thomas' NHS Foundation Trust, London, UK. [2]National Heart and Lung Institute, Imperial College London, London, UK. [3]Hillingdon Integrated Respiratory Service, Hillingdon Hospitals NHS Foundation Trust, London, UK. [4]Harefield Pulmonary Rehabilitation Unit, Royal Brompton and Harefield Hospitals, Guy's and St Thomas' NHS Foundation Trust, London, UK.

Correspondence: Claire M. Nolan, Royal Brompton and Harefield NHS Foundation Trust, Harefield Hospital, Middlesex, UB9 6JH, UK. E-mail: c.nolan@rbht.nhs.uk

References

1 Gimeno-Santos E, Frei A, Steurer-Stey C, *et al.* Determinants and outcomes of physical activity in patients with COPD: a systematic review. *Thorax* 2014; 69: 731–739.
2 Boeselt T, Spielmanns M, Nell C, *et al.* Validity and usability of physical activity monitoring in patients with chronic obstructive pulmonary disease (COPD). *PLoS One* 2016; 11: e0157229.
3 Pitta F, Troosters T, Probst V, *et al.* Quantifying physical activity in daily life with questionnaires and motion sensors in COPD. *Eur Respir J* 2006; 27: 1040–1055.
4 Nolan CM, Maddocks M, Canavan JL, *et al.* Pedometer step count targets during pulmonary rehabilitation in chronic obstructive pulmonary disease. A randomized controlled trial. *Am J Respir Crit Care Med* 2017; 195: 1344–1352.
5 Furberg CD, Friedman LM. Approaches to data analyses of clinical trials. *Prog Cardiovasc Dis* 2012; 54: 330–334.
6 British Thoracic Society. Quality Standards for Pulmonary Rehabilitation in Adults. May 2014. Available from: https://www.brit-thoracic.org.uk/quality-improvement/quality-standards/pulmonary-rehabilitation/
7 Nolan CM, Kaliaraju D, Jones SE, *et al.* Home *versus* outpatient pulmonary rehabilitation in COPD: a propensity-matched cohort study. *Thorax* 2019; 74: 996–998.
8 Juniper EF, Guyatt GH, Willan A, *et al.* Determining a minimal important change in a disease-specific quality of life questionnaire. *J Clin Epidemiol* 1994; 47: 81–87.
9 Teylan M, Kantorowski A, Homsy D, *et al.* Physical activity in COPD: minimal clinically important difference for medical events. *Chron Respir Dis* 2019; 16: 1479973118816424.
10 Demeyer H, Burtin C, Hornikx M, *et al.* The minimal important difference in physical activity in patients with COPD. *PLoS One* 2016; 11: e0154587.

11   Kon SS, Canavan JL, Jones SE, *et al.* Minimum clinically important difference for the COPD Assessment Test: a prospective analysis. *Lancet Respir Med* 2014; 2: 195–203.

12   Singh SJ, Jones PW, Evans R, *et al.* Minimum clinically important improvement for the incremental shuttle walking test. *Thorax* 2008; 63: 775–777.

13   Nolan CM, Delogu V, Maddocks M, *et al.* Validity, responsiveness and minimum clinically important difference of the incremental shuttle walk in idiopathic pulmonary fibrosis: a prospective study. *Thorax* 2018; 73: 680–682.