Functional status measures for the COPD patient: A practical categorization

Suzanne Claire Lareau1* and Felicity Clair Blackstock2

Abstract
The objective of this study is to review available functional status measures (FSMs) validated for use in the chronic obstructive pulmonary disease (COPD) population and categorizing the measures by their commonalities to formulate a framework that supports clinicians in the selection and application of FSMs. A literature review identifying valid and reliable measures of functional status for people with COPD was undertaken. Measures were thematically analyzed and categorized to develop a framework for clinical application. A variety of measures of activity levels exist, with 35 included in this review. Thematic categorization identified five categories of measures: daily activity, impact, surrogate, performance-based, and disability-based measures. The vast variety of FSMs available for clinicians to apply with people who have COPD may be overwhelming, and selection must be thoughtfully based on the nature of the population being studied/evaluated, and aims of evaluation being conducted, not simply as a standard measure used at the institution. Psychometric testing is a critical feature to a strong instrument and issues of reliability, validity, and responsiveness need to be understood prior to measurement use. Contextual nature of measures such as language used and activities measured is also important. A categorical framework to support clinicians in the selection and application of FSMs has been presented in this article.

Keywords
Functional status measures, COPD, practical categories, psychometric properties

Date received: 18 June 2018; accepted: 25 October 2018

Introduction
Functional status measures (FSMs) are instruments generally used to evaluate the impact of a person’s health condition on their ability to perform activities. These measures have also been referred to as activity (or functional status) measures, questionnaires, instruments, or tools. FSMs were initially developed to describe an individual’s participation in activities of daily living; however, functional status is sometimes more broadly used as a term for the evaluation of other types of function such as social, psychological, physiologic, and emotional. This article will use the term FSM as it relates to the direct or indirect measurement of activity by patients with chronic obstructive pulmonary disease (COPD).

Why measure activities? FSMs can provide detailed information on what individuals do, providing a window into the daily life of patients. The development of FSMs in the 1950s and 1960s focused on grading disability or the degree to which patients...
required assistance in the long-term residential care setting. However, since this time, expansion of the application of FSMs, such as for patients with chronic disease, has allowed clinicians to use FSMs to describe progress secondary to the disease, or in response to therapy.

In the past 30 years, there has been a great deal of interest in quantifying the degree of activity limitation for patients with COPD. During this time, activity monitors were introduced to measure activity levels as purportedly, a more reliable method due to their objective nature, as opposed to the subjective nature of FSMs. However, activity monitors have limitations in measuring small changes in daily life and patterns of activities in patients. Compared to FSMs, activity monitors have the disadvantages of expense, limitation in detecting steps in those with slow walking speed, evaluation of predominantly lower extremity movement, and failure in some instances to provide information specific to what activity is being performed, for example, making a bed versus washing the dishes. More recently, attempts have been made to evaluate patients with both types of measures, resulting in complimentary information being gathered.

Numerous FSMs exist, most developed for purposes of measuring activities in patients other than COPD. Many have the potential to be applied in the COPD population after the measure has undergone appropriate psychometric testing. For example, the Nottingham Extended Activities of Daily Living Scale was developed in the 1980s for use with stroke patients, and has now been validated for use in the COPD population. This transferability of FSMs between patient population groups has led to a vast array of measures being available to clinicians, with a potential for confusion over which measure is the most appropriate for specific scenario use. Observing patterns of uniqueness of measures led the authors of this article to consider categorizing FSMs to support clinicians in decision-making. Providing a categorical framework of FSMs for the pulmonary community would be beneficial for greater clarity in the selection and informed application of these measures.

The purpose of this article is to review available FSMs that have been validated for use in the COPD population and categorizing the measures by their commonalities. Characteristics and unique qualities of the instruments will be highlighted, and a framework for selection of a measure will be presented to support the appropriate application of the measures for both clinicians and researchers. The features presented will include ease of use (reflected in time to administer, scoring, etc.), time frame, psychometric properties (e.g. validity, reliability, responsiveness), and minimal clinically important difference (MCID).

Methods

Establishing the FSM categories was completed in three phases. First, FSMs were identified that were commonly used in COPD patients through a literature search of PubMed and Google Scholar. Three recent systematic reviews of FSMs were identified, published in 2014 and 2016 and FSMs presented in these systematic reviews obtained. A reference list check of all papers included in the review was also completed to source all FSMs for use with COPD patients. Measures that were included in the synthesis had to meet the following criteria:

1. Validated for use with the COPD population.
2. Documented beginning psychometric properties of the measure, reporting on validity and reliability.
3. Published in English.
4. Full-text articles published in peer review publications.
5. Tools publicly available to review.

Instruments were excluded if they were not found to have been used in COPD patients, were never tested or used beyond the initial development after 5 years or more, have not been used for measurement with the COPD population for a decade or more, or where the scoring system changed too frequently to reliably report the psychometric properties. Papers considered for inclusion were reviewed by the two authors, and consensus reached on inclusion by discussion.

The second phase was to complete a subsequent search of PubMed and Google Scholar to obtain copies of the measures and the literature reporting on the psychometric properties of all FSMs identified for inclusion. The psychometric properties of the FSMs were then extracted from the papers by one author. While psychometric properties often receive less attention, inadequate testing of measures may result in failure to obtain the desired information about the patient/study, or provide false or misleading conclusions. Responsiveness of the instrument measuring the activity for impact of COPD or following treatment (e.g. pulmonary rehabilitation) was also recorded. The MCID of the measure was noted;
however, as this information was not always available, papers were not excluded if MCID had not been determined.

Descriptive analysis of the components of the measures was then undertaken by one of the authors, grouping papers based on the purpose of the FSM, number of activities evaluated, how the activities were evaluated, how the FSM was administered, and whether it was tested and used in COPD patients. Finally, the instruments were thematically organized according to concepts. Initially, information on the types of activities measured, the number of activities evaluated, time taken to complete the entire measure, total number of items (questions) in the measure, time frame for administering, psychometric measurement properties (as previously described), and process of completing the measure, including scoring and whether nominal, ordinal, or interval scores, were extracted from the papers. The purpose of the FSM was the primary driver in developing the themes.

Results
A total of 61 FSMs were identified, with 35 included in this review and thematic analysis. A list of all FSMs reported for use with COPD patients are provided in Table 1, noting rationale for those excluded. The main reasons for exclusion were, they had either not been tested in the COPD population or testing was limited to the initial instrument development.

Categories of measures
Five themes of measures were identified: daily activities, impact, surrogate, indirect performance-based, and disability-based measures. These themes formed five categories of measures.

1. Measures that looked at participation in a variety of activities were labeled Activity Measures. These measures evaluated the ability of the patient to engage in numerous activities often assessing domains of self-care, home management, ambulation, and participation in social and recreational activities.

2. Activities that were associated with symptoms were labeled Impact Measures. These measures evaluated how symptoms (primarily dyspnea and/or fatigue) affected the person’s ability to participate in activities. A measure that is classically used to measure dyspnea is the Medical Research Council (MRC) Scale\(^46,47\); however, because this scale focuses on the effect of dyspnea on walking limitations, it could also be considered an Activity Measure. Additionally, one could argue that the MRC reflects disability because like the Disability Measures, the MRC categorizes patients as ambulatory or housebound.

3. Where activities were subscales or domains of health status questionnaires, such as the physical function subscale of the Medical Outcomes Study/SF-36,\(^69\) these measures were labeled Surrogate Measures of activities. These subscales are often used as substitutes to establish concurrent validity of Activity Measures; however, the activities in these Surrogate Measures sometimes included evaluation of emotional function making them not purely FSMs. The domains of these health status measures comprise part of a total score that reflects overall health status or health-related quality of life. Where feasible, the psychometric properties of the individual domains/subscales were reported.

4. Indirect Performance-Based Measures as a category describes measures used to evaluate the individual’s potential to engage in activities by observation of typical body motions. There are limited numbers of these measures but their contribution to understanding patients’ limitations in activities made them candidates as FSMs.

5. Disability-Based Measures either observe and rate an activity or have the individual self-report their level of independence with activities. These instruments were initially designed for patients in long-term care settings such as nursing homes or those limited in activity due to stroke or orthopedic surgery.

Figure 1 provides a pictorial illustration of how these categories address functional status. For example, the Activity Category measures “do you do it (the activity listed)?” In relation to activities, the Disability Category asks, “can you do it?” and so on.

Of the measures identified, 17 instruments were deemed to fit in the category of Activity, 5 Impact, 5 Surrogate, 3 Performance-based, and 5 Disability-based measures. It was noted that some measures could be considered overlapping with other
Table 1. List of FSMs considered for inclusion with reasons for exclusion.

| Measure                                                                 | Included/excluded | Reason for exclusion                                                                 |
|------------------------------------------------------------------------|-------------------|--------------------------------------------------------------------------------------|
| Activities Checklist                                                  | Excluded          | No known use in COPD patients                                                        |
| Activities of Daily Living Index (AKA Frenchay Activities Index)       | Excluded          | No known use in COPD patients                                                        |
| Activities of Daily Living Inventory (ADLI)                            | Excluded          | No known in COPD use since original development, and limited testing                 |
| Activities of Daily Living Questionnaire (ADLQ)                        | Excluded          | Last known use in COPD patients >10 years.                                            |
| Activities of Daily Living Test                                        | Excluded          | No known use in COPD patients                                                        |
| Activities of Daily Living Simulation Test                            | Excluded          | Limited psychometric testing. Performance and types of activities altered in studies of COPD patients. |
| Adelaide Activities Profile (AAP)                                      | Excluded          | No known use in COPD patients                                                        |
| Baecke Physical Activity Questionnaire                                 | Excluded          | Types of activities designed for healthy, active elderly                               |
| Barthel Index (BI)                                                    | Included          |                                                                                      |
| Barthel Index Modified (BIM)                                           | Included          |                                                                                      |
| Baseline Dyspnea/Transitional Dyspnea Index                            | Included          |                                                                                      |
| Canadian Occupational Performance Measure (COPM)                      | Included          |                                                                                      |
| Capacity of Daily Living in the Morning (CDLM)                        | Excluded          | Activities specific to morning symptoms                                              |
| Clinical Respiratory Disease Questionnaire (CRQ or CRDQ)              | Included          |                                                                                      |
| COPD Activity Rating Scale (CARS)                                     | Excluded          | First and last known use in 2003 when developed.                                     |
| Community Healthy Activities Model Program for Seniors (CHAMPS)        | Included          |                                                                                      |
| Customary Activity Questionnaire                                      | Excluded          | Last known use in respiratory in 1998                                                |
| Duke Activity Status Index (DASI)                                      | Included          |                                                                                      |
| EuroQOL-ED 5D-5 L and VAS                                              | Included          |                                                                                      |
| Fitness Arthritis and Seniors Trial (FAST)                            | Excluded          | No known use in pulmonary patients                                                    |
| Frenchay Activities Index (FAI)                                        | Excluded          | Multiple versions of scoring and variable number of activities make the FAI difficult to evaluate reliably |
| Functional Activities Questionnaire                                    | Excluded          | No known use in COPD patients                                                        |
| Functional Performance Inventory (FPI)                                 | Included          |                                                                                      |
| Functional Performance Inventory (Short Form) (FPI-SF)                | Included          |                                                                                      |
| Functional Status Questionnaire                                       | Excluded          | No known use in COPD patients since 1980s                                            |
| Glittre Test                                                           | Included          |                                                                                      |
| Groningen Activity Restriction Scale (GARS)                            | Included          |                                                                                      |
| Human Activity Profile (HAP)                                           | Included          |                                                                                      |
| Index of Independent Activities of Daily Living Scale (Index of ADL)  | Excluded          | Limited testing and little use in COPD                                               |
| Instrumental Activities of Daily Living                               | Excluded          | Last known use in COPD patients was 1994                                             |
| Karnofsky Performance Scale (KPS)                                      | Included          | Measure of functional impairment (health to death)                                   |
| London Chest Activity of Daily Living Scale (LCADL)                   | Included          |                                                                                      |
| London Handicap Scale                                                  | Excluded          | Measure of handicap                                                                   |
| Londrina Activities of Daily Living Protocol                         | Included          |                                                                                      |
| Manchester Respiratory Activities of Daily Living Questionnaire (MRADL) | Included          |                                                                                      |
| Meaningful Activity Participation Assessment (MAPA)                  | Excluded          | Developed for those with mental illness to describe the quality/meaningfulness of activities |
| Medical Research Council (MRC)                                        | Included          |                                                                                      |
| Milliken ADL Scale (MAS)                                              | Included          |                                                                                      |

(continued)
**Table 1.** (continued)

| Measure                                                                 | Included/excluded | Reason for exclusion |
|------------------------------------------------------------------------|-------------------|----------------------|
| Minnesota Leisure Time Physical Activity Questionnaire49               | Excluded          | Limited use in COPD patients |
| Monitored Functional Task Evaluation (MFTE)50                          | Included          | Designed for inpatient rehabilitation assessing mobility, toilet function and cognition, not specifically evaluated for COPD patients |
| Motor subscale of the Functional Independence Measure (FIM)51           | Excluded          |                      |
| Nagasaki University Respiratory Activity of Daily Living Questionnaire52| Excluded          | No known use or testing since original development in 2009 |
| Nottingham Extended Activities of Daily Living Questionnaire (NEADL)3  | Included          |                      |
| Oxygen Cost Diagram (OCD)53                                            | Included          |                      |
| Oxford Participation and Activities Questionnaire (Ox-PAQ)54           | Excluded          |                      |
| Physical Activity Scale for the Elderly (PASE)55                       | Included          |                      |
| ProActive56                                                            | Included          |                      |
| Pulmonary Functional Status Scale (PFSS)57                             | Included          |                      |
| Pulmonary Functional Status Scale (PFSS-11)58                           | Excluded          | Testing to limited to development |
| Pulmonary Functional Status Scale (Short Version) (PFSS-35)57           | Included          |                      |
| Pulmonary Functional Status and Dyspnea Questionnaire (PFSDQ)59         | Included          |                      |
| Pulmonary Functional Status and Dyspnea Questionnaire modified version (PFSDQ-M)60| Included |                      |
| Saint George’s Respiratory Questionnaire (SGRQ)61                      | Included          |                      |
| Short Form 36 of Medical Outcomes Study (SF-36)62                      | Included          |                      |
| Stanford 7-Day Physical Activity Recall (PAR)63                        | Included          | No known use in COPD patients since 1989 |
| The Valued Life Activity Scale64                                        | Included          |                      |
| Townsends Disability Scale65                                            | Excluded          |                      |
| University of San Diego Shortness of Breath Questionnaire (SOBQ)66      | Included          |                      |
| Yale Physician Activity Survey (YPAS)67                                 | Included          |                      |
| Zutphen Physical Activity Questionnaire (ZPAQ)68                        | Included          |                      |

FSM: functional status measure; AKA: also known as; COPD: chronic obstructive pulmonary disease; VAS: visual analog scale.

categories. For example, FSMs among the Impact Measures were a reflection of both an individual’s participation in activities (Activity Measure) and symptoms with the activity (Impact). However, because these measures ask what activities individuals have reduced or no longer perform because of dyspnea (e.g. Oxygen Cost Diagram, MRC, etc.), they were also candidates for being considered Activity Measures. Where there was overlap, these measures are noted in the comment column of each table (Tables 1 to 5), and explicitly presented for each FSM in Table 6. For example, the MRC is an Impact measure, but overlaps with both the Activity and Disability measures.

**Design and psychometric properties of the FSMs**

Tables 1 to 5 summarize the characteristics of each measure, presenting measures by each of the aforementioned categories. The number of activities evaluated is reported for each measure (specifically the number of unique activities addressed in each measure). Those measures with more activities often allow a better understanding of the breadth of activities affecting the patient. The fewer the activities, the less time to complete, especially with dichotomous (Yes/No) answers. However, Yes/No responses may provide limited information. For example, brevity may sacrifice information on the frequency, the
difficulty or the need for assistance with the activity or if the activity is no longer performed due to a respiratory problem. It was noted that in selected FSMs, if the patient did not perform the activity, they are asked to estimate their performance if they could engage in the activity. No studies are known to evaluate the consequences of this type of estimate on the validity of the data.

The types of activities evaluated are diverse across all measures. The user should consider if the activities of the FSM satisfy their needs for understanding their population. For example, activities designed for a younger or healthier older population (e.g. playing soccer, cycling, etc.) are less relevant to patients who are impaired from their respiratory problem or other comorbidity such as poor balance. Activities that may be more gender-specific may result in missing data (e.g. cooking, washing laundry, mowing the lawn, etc.), because these activities may not be undertaken equally among genders. The type of scoring is important, since some responses are dichotomous, or on a 0–10 scale, while others ask for the frequency and time spent in the activity. Generally, the more complex the scoring (e.g. weighted or reversed scoring), the more time-consuming scoring becomes, unless a computerized program is readily available.

Most measures reviewed were self-reports; however, some categories had predominantly observer/assessor ratings. This was true for the Performance-based measures. The time to take/administer the instruments were often under 10 minutes (range 1–20 minutes). Instruments varied in the time frame in which the activity was performed ranging from current to past 3 months. Time frame is a consideration if an intervention requires more time to take effect than identified in the FSM. Of note, the psychometrics of the instrument may be changed if a user randomly selects a time frame or does not utilize the entire measure (e.g. only administers one domain of an FSM) other than specified by the developer.

Discussion

This review of the literature has identified a diverse range of measures available to the clinician evaluating functional status for people with COPD. This diversity likely reflects the numerous reasons why functional status is measured for people with COPD in the

Figure 1. An illustration of the five categories of functional status measures.
Table 2. Description and psychometric properties of daily activity measures.

| Measure | Activities (#) | Rating of activities | Time to complete (minutes) | Time frame | Validity | Reliability | Responsiveness and MCID | Comments |
|---------|---------------|----------------------|---------------------------|------------|----------|-------------|-------------------------|----------|
| Community Healthy Activities Model Program for Seniors (CHAMPS)²⁵ | 41 | RA | Frequency (f) | 10–15 minutes | Typical week in past 4 weeks | Content²⁰,²¹ | Test-retest @ 2 weeks by mail: Moderate act r = 0.96, All act r = 0.62²¹ ICC = Moderate act 0.67, All act 0.66 over 6 months²⁰ @ 2 weeks: Moderate = 0.76, All = 0.62²¹ | Not responsive to OT intervention⁷⁷ | • A measure of physical activity to change behavior in older adults • Present list of activities, evaluate for f and duration • Many act geared to older, healthy adults (e.g. golf, jogging) • Change in scores not associated with change in SF-36 PF²⁵ • Limited testing and use in COPD • Developed for occupational therapists to detect changes in domestic function • Five-step process, for example, identify difficult activity, rate its importance, satisfaction with performance, and so on. • Domains: self-care, productivity and leisure. • Weighted scoring • May not be responsive to all interventions • Developed to measure functional capacity in cardiovascular patients • Limited use and testing in COPD • Weighted scoring |
| Canadian Occupational Performance Measure (COPM)¹⁹ | 9 | RA | Rating 1–10 | 10–20 minutes | Current | Content¹⁹ | Test-retest: r = 0.63 satisfaction, r = 0.84 performance, ICC = 0.81 for satisfaction, 0.76 for performance⁷³ ICC = Moderate act 0.67, All act 0.66 over 6 months²⁰ @ 2 weeks: Moderate = 0.76, All = 0.62²¹ | Not responsive to OT intervention⁷⁷ | • A measure of physical activity to change behavior in older adults • Present list of activities, evaluate for f and duration • Many act geared to older, healthy adults (e.g. golf, jogging) • Change in scores not associated with change in SF-36 PF²⁵ • Limited testing and use in COPD • Developed for occupational therapists to detect changes in domestic function • Five-step process, for example, identify difficult activity, rate its importance, satisfaction with performance, and so on. • Domains: self-care, productivity and leisure. • Weighted scoring • May not be responsive to all interventions • Developed to measure functional capacity in cardiovascular patients • Limited use and testing in COPD • Weighted scoring |
| Duke Activity Status Index (DASI)²⁷ | 12 | SA | Yes/No | 3 minutes | Current | Construct²⁹ | Test-retest: ICC = 0.95⁸¹ Internal consistency (in heart failure): α = 0.86⁸¹ | NA | • A measure of physical activity to change behavior in older adults • Present list of activities, evaluate for f and duration • Many act geared to older, healthy adults (e.g. golf, jogging) • Change in scores not associated with change in SF-36 PF²⁵ • Limited testing and use in COPD • Developed for occupational therapists to detect changes in domestic function • Five-step process, for example, identify difficult activity, rate its importance, satisfaction with performance, and so on. • Domains: self-care, productivity and leisure. • Weighted scoring • May not be responsive to all interventions • Developed to measure functional capacity in cardiovascular patients • Limited use and testing in COPD • Weighted scoring |

(continued)
| Measure | Activities (#) | Self-/rater-administered | Rating of activities | Time to complete (minutes) | Time frame | Validity | Reliability | Responsiveness and MCID | Comments |
|---------|----------------|---------------------------|----------------------|---------------------------|-----------|----------|-------------|------------------------|----------|
| Functional Performance Inventory (FPI) | 65 | SA | Degree of difficulty | 20 | Current | Content | Test–retest ICC = 0.87 | NA | Developed to assess level of difficulty with activity in COPD |
| | 32 | | 1 = none, 2 = some, 3 = much, 4 = don’t do due to health | 85 | 85 items | Construct | Concurrent ICC = 0.8 | NA | Subscales: body care, housework, exercise, recreation, social and spiritual |
| | | | TS = 0–3 (high scores better health, due to reverse scoring) | | | Concurrent | Internal consistency $\alpha = 0.92$ and $0.93$ | | NA option if don’t do activity for reasons other than health |
| Functional Performance Inventory Short Form (FPI-SF) | 32 | SA | Difficulty: 0 = don’t perform due to health or choose not to do, 1 = much difficulty, 2 = some, 3 = none | 10 | Current | Content | Test–retest ICC = TS 0.88 | NA | Reverse scoring |
| | | | TS = 0–3 (the mean of 6 subscales) (low scores better health) | 0 at 2 weeks | | Concurrent | Internal consistency | 0.93 | Developed to assess level of difficulty with activities in COPD |
| | | | | NA | | Discriminant | TS $\alpha = 0.89$ | | Subscales unchanged from FPI |
| Human Activity Profile (HAP) | 94 (activity) | SA | Act = still doing, stopped doing, never did activity | 5–7 | Current | Content | Test–retest 5–14 days MAS $r = 0.76$ | Responsive to PR | Developed to evaluate energy expenditure for COPD patients in PR |
| Formerly called Additive Activities Profile Test | 8 (dyspnea) | | Dysp = none, yes a little, yes noticeable, yes severe | 102 items | | Concurrent | 5–14 days AAS $r = 0.79$ | | Domains: activity and dyspnea with 4 subscales: self-care, personal/housework, entertainment/social, and independent exercise |
| | | | Scores: MAS—maximum act score | | | | | | | SF-36PF and MAS $r = -0.63$ |
| | | | AAS—adjusted act scores | | | | | | | AAS $r = -0.70$ |
| | | | Scoring: 0–94 (high scores, higher function) | | | | | | | VO$_2$ and MAS $r = 0.76$ |
| | | | MAS $r = 0.97$ | | | | | | | AAS $r = 0.85, p < 0.05$ |
| | | | ICC = MAS 0.76, AAS 0.87 | | | | 6MWD and MAS $r = 0.45$ AAS $r = 0.61$ (both $p < 0.1$) |
| | | | Internal consistency $\alpha = 0.84$ | | | | | | | Limited use and testing in COPD since its development |
| | | | | | | | | | | overlaps with Impact Measures |

(continued)
| Measure | Activities (#) | Rating of activities | Time to complete (minutes) | Time frame | Validity | Reliability | Responsiveness and MCID | Comments |
|---------|---------------|----------------------|---------------------------|------------|----------|-------------|------------------------|----------|
| Milken ADL Scale (MAS) | 47 SA | 5-point scale on ability (1 = unable to, 5 = able to do) as “prior to surgery” 3-point scale on necessity. Scoring = ability 47–235 necessity 47–141 Integrated score 47–705 | 10 minutes | current | Content48 | Test–retest at 2–7 days, r = 0.9148 ICC 0.7791 Internal consistency α = 0.9671 | Responsive to PR (only for housecleaning and other tasks)76 MCID = NA | • Developed to measure upper extremity disability  
• Six sections representing clusters of tasks = meal preparation, personal hygiene, dressing, object manipulation, housecleaning, and other.  
• Developed to assess healthy people  
• Domains: leisure and occupational activities  
• Estimates individuals’ time spent in physical activity by category of METS (moderate, hard, and very hard)  
• Reliability predominantly done in young, healthy  
• Accel time spent in >3 METS r = 0.83, p < 0.001  
• <3 METS p ≥ 0.0593  
• Weak assessing activity level at individual level, but potential for stratifying COPD according to activity levels93  
• Measures physical activity in the elderly  
• Domains: leisure, household, and occupational  
• Many (8/12) sports and household activities  
• PASE and VO2 r = 0.56, p < 0.0176  
• 6MWD r = 0.68, p < 0.0171  
• SF36 PF r = 0.30 p < 0.0171  
• Accel r = 0.19 p > 0.0593  
• Cutoff of <11 for sedentary act, TS95  
• Limited use and testing in COPD  
• Weighted scores |
| Stanford 7-Day Physical Activity Recall (PAR)63 (AKA Modified Activity Recall Questionnaire (MARQ)) | 4 RA | Identify time spent in sleep and activities for 7 days. Scoring: Total EE score (kcal/kg/day) Time spent in moderate act | 20 minutes | Past 7 days | Concurrent92 | Test–retest 14 days  r = 0.67 Total EE r = 0.83 vigorous act r = 0.83 moderate act r = 0.7544 NA in COPD | TEE SWA (r = 50.83, p < 0.001). ≥3 METs correlated significantly with SWA-derived time a3 METs (r = 0.54, p < 0.001) and with SWA-derived PAL r = 0.46, p = 0.00293 | • Creates a score for each day (low score = low activity, high score = high activity)  
• Summed over 7 days as PAR score  
• Based on the Modified Activity Recall Questionnaire (MARQ)  
• Scoring: Total EE score (kcal/kg/day) Time spent in moderate act  
• Test–retest 14 days  r = 0.67 Total EE r = 0.83 vigorous act r = 0.83 moderate act r = 0.7544 NA in COPD |
| Physical Activity Scale for the Elderly (PASE)55 | 12 SA | Frequency and duration TS a two-step process 1. Time (hours/week) in each activity 2. Weighting of each activity Scoring: 0–361 (high scores high act level) | 5 minutes | Past 7 days | Construct55,71 Disciminant71 | Test–retest 3–7 weeks r = 0.7555 At 5 days r = 0.7555 Internal consistency α = 0.6955 | NA | • Measures physical activity in the elderly  
• Domains: leisure, household, and occupational  
• Many (8/12) sports and household activities  
• PASE and VO2 r = 0.56, p < 0.0176  
• 6MWD r = 0.68, p < 0.0171  
• SF36 PF r = 0.30 p < 0.0171  
• Accel r = 0.19 p > 0.0593  
• Cutoff of <11 for sedentary act, TS95  
• Limited use and testing in COPD  
• Weighted scores |
| Measure                                      | Activities (#) | Self-/rater-administered | Rating of activities                                                                 | Time to complete (minutes) # items | Time frame          | Validity     | Reliability          | Responsiveness and MCID | Comments                                                                 |
|----------------------------------------------|----------------|--------------------------|-------------------------------------------------------------------------------------|-----------------------------------|---------------------|--------------|----------------------|----------------------------|--------------------------------------------------------------------------|
| Pulmonary Functional Status Scale (PFSS)⁵⁷   | 22             | SA                       | Rating varies with questions (e.g. difficulty, yes/no, blocks, frequency, independent, etc.) Scoring mean of each scale (9–34), high scores better function | 15 mins 56 items                  | Current, past week, past month | Content⁵⁷   | Internal consistency $\alpha = 0.83$⁵⁷ | Responsive to PR⁵⁷          | MCID = NA • Developed as a disease-specific outcome measure of older adults with chronic lung disease. • 3 subscales: daily activities/social, psychologic, and sexual functioning • Weighted and reverse scoring • PFSS reduced from 56 to 35 items • Domains unchanged • Weighted and reverse scoring |
| Pulmonary Functional Status Scale (modified) (PFSS-modified)⁵⁷,⁹⁸ | 18             | SA                       | Scoring (1–15) with high scores better function                                      | NA 35 items                       | Current, past week, month | Construct⁹⁸ | Test–retest $r = 0.67$⁷⁷ | Responsive to PR⁹⁹          | MCID = NA • Developed to evaluate changes in activity and dyspnea levels and dyspnea in COPD • Activities (79) evaluated for participation and 79 for impact of dyspnea • Option to check if never performed the activity • PFSDQ act and 6MWD Spearman $p = 0.42$; PFSDQ dysp $p = 0.47$, $p < 0.001$³⁵ • Dyspnea scale overlaps with Impact Measures |
| Pulmonary Functional Status and Dyspnea Questionnaire* (PFSDQ)⁵⁹ | 79 activities act (79) dysp (79) | SA                       | Act: 0 = as active as ever to 10 = omitted entirely due to breathing Dysp: 0 = none to 10 = extreme dysp Act and dysp TS = 0–790 on each Act and dysp Mean = 0–10 dysp has five stand-alone scores for $f$ and intensity | 15mins 164 items                  | Current              | Content⁵⁹   | Internal consistency $\alpha = 0.93$³⁷ | MCID TS = 10                | Responsive⁵⁹ • Developed to evaluate changes in activity and dyspnea levels and dyspnea in COPD • Activities (79) evaluated for participation and 79 for impact of dyspnea • Option to check if never performed the activity • PFSDQ act and 6MWD Spearman $p = 0.42$; PFSDQ dysp $p = 0.47$, $p < 0.001$³⁵ • Dyspnea scale overlaps with Impact Measures |

(continued)
### Table 2. (continued)

| Measure                                      | Activities (#) | Rating of activities                                                                 | Time to complete (minutes) | Time frame | Validity | Reliability | Responsiveness and MCID | Comments                                                                                     |
|----------------------------------------------|---------------|--------------------------------------------------------------------------------------|----------------------------|------------|-----------|-------------|--------------------------|---------------------------------------------------------------------------------------------|
| pulmonary functional status and dyspnea       | 10 activities | Three domains (act, dysp, fat)                                                       | 7 minutes                  | Current    | Construct | Test–retest 2 weeks   | Responsive to PR               | • Modified from PFSDQ to reduce # activities and measure fatigue.                             |
| questionnaire (modified version)* (PFSDQ-M)   |               | act: 0 = as active as ever to 10 = omitted entirely due to breathing                 |                            |            |           | act = 0.70    |                           | • PFSDQ-M act and 6MWD                                                      |
|                                              |               | dysp/fat                                                                             |                            |            |           | dysp = 0.83   |                           | • r = 0.34, p < 0.01                                                       |
|                                              |               | 0 = none                                                                             |                            |            |           | fat = 0.79    |                           | • r = −0.30, p < 0.001                                                      |
|                                              |               | 10 = extreme                                                                         |                            |            |           | ICC =        |                           | • PFSDQ-M act and CRQ dysp                                                   |
|                                              |               | For each domain report                                                               |                            |            |           | act = 0.79    |                           | • r = −0.32, p < 0.001                                                      |
|                                              |               | TS = 0–100                                                                           |                            |            |           | dysp and fat =|                           | • PFSDQ-M act and SGRQ act                                                    |
|                                              |               | Mean = 0–10                                                                          |                            |            |           | 0.77 at 1 week |                           | • r = 0.76, p < 0.000                                                      |
|                                              |               |                                                                                        |                            |            |           | ICC =        |                           | • 6–8 grade reading level                                                    |
|                                              |               |                                                                                        |                            |            |           | act = 0.90    |                           | • Dysp and fat domains overlap with Impact Measure                             |
|                                              |               |                                                                                        |                            |            |           | dysp = 0.93   |                           |                                                                            |
|                                              |               |                                                                                        |                            |            |           | fat = 0.92 at 2 days |                           |                                                                            |
|                                              |               |                                                                                        |                            |            |           | Internal consistency |                           |                                                                            |
|                                              |               |                                                                                        |                            |            |           | act = 0.93; |                           |                                                                            |
|                                              |               |                                                                                        |                            |            |           | dysp and fat = 0.95; |                           |                                                                            |
|                                              |               |                                                                                        |                            |            |           | with arm act = 0.87 |                           |                                                                            |
|                                              |               |                                                                                        |                            |            |           | all act = 0.93 |                           |                                                                            |
|                                              |               |                                                                                        |                            |            |           | Content       |                           |                                                                            |
|                                              |               |                                                                                        |                            |            |           | Construct    |                           |                                                                            |
|                                              |               |                                                                                        |                            |            |           | Convergent    |                           |                                                                            |
| PROactive questionnaire*                    | 4 ratings: none at all to all the time rarely, sometimes, frequently and all the time. | NA                        | Past 7 days | NA         | 12 items   | Test–retest   | ICC ≥ 0.90               | • Developed to evaluate the impact of disease on activities                          |
|                                              |               |                                                                                        |                            |            |           | Internal consistency |                           | • Measures amount and difficulty with activities.                                  |
|                                              |               |                                                                                        |                            |            |           | act = 0.87   |                           | • Several activities relate to symptoms                                            |
|                                              |               |                                                                                        |                            |            |           | all act = 0.87 |                           | • Newly developed measure, still undergoing psychometric testing                |
|                                              |               |                                                                                        |                            |            |           | Content       |                           | • 8–9-year-old reading level                                                  |
|                                              |               |                                                                                        |                            |            |           | Construct    |                           | • Overlap with Impact Measure                                                 |
| Measure                                   | Activities (#) | Self-/rater-administered | Rating of activities | Time to complete (minutes) | # items | Time frame | Validity | Reliability | Responsiveness and MCID | Comments                                                                                                                                 |
|------------------------------------------|----------------|--------------------------|----------------------|---------------------------|---------|------------|----------|-------------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| **The Valued Life Activities (VLA)**     | 28 act in COPD | SA                       | 0–3 rating           | NA                        | Current | Content    | Predictive | Internal consistency | NA                       | Developed to evaluate the impact of arthritis by assessing disability based on personal values |
|                                         |                |                          | 0 = no difficulty    |                           |         |            | Discriminant | on 13 domains (arthritis) |                           | 3 subscales (# act) obligatory (6), committed (9), discretionary (13) |
|                                         |                |                          | 3 = unable to do.    |                           |         |            |           | Controls |                           | Rate act perform or don't perform due to respiratory condition |
|                                         |                |                          | TS                   |                           |         |            |           | α = 0.63–0.88 |                           | Then rate difficulty with performance |
|                                         |                |                          | 0–1.0                |                           |         |            |           | Controls | α = 0.60–0.86 |                           | Limited testing and use in COPD |
|                                         |                |                          | 0–100%               |                           |         |            |           |                           |                           | Developed to measure activity in healthy older adults |
|                                         |                |                          | Sub scores for       |                           |         |            |           |                           |                           | Activities; work (10 act), yardwork (3 act), caretaking (2 act), exercise (5 act), recreation (7 act) |
|                                         |                |                          | obligatory           |                           |         |            |           |                           |                           | 2 sections to develop 8 indices to determine vigorous, act, low intensity general movement, and time in recreation act |
|                                         |                |                          | committed            |                           |         |            |           |                           |                           | May be useful screen of sedentary activities |
|                                         |                |                          | discretionary        |                           |         |            |           |                           |                           | EE and 6MVWT \( r = 0.58, p < 0.01 \) |
|                                         |                |                          | activities           |                           |         |            |           |                           |                           | EE and SF36 PF \( r = 0.31, p < 0.01 \) |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | accel \( r = 0.61, p < 0.01 \) |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | Limited use and testing in COPD |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | Weighted scoring |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | Scoring may be cumbersome |
| **Yale Physician Activity Survey (YPAS)**| 27 RA          |                          | Summary indices:     |                           |         | Typical    | Convergent | Test–retest 14 day       | NA                       | Developed to evaluate the impact of arthritis by assessing disability based on personal values |
|                                         |                |                          | -Total time/each act |                           |         | week in    | weak      | Total time \( r = 0.57 \); |                           | 3 subscales (# act) obligatory (6), committed (9), discretionary (13) |
|                                         |                |                          | -EE (kcal/week);     |                           |         | month      |           | EE \( r = 0.58 \);         |                           | Rate act perform or don't perform due to respiratory condition |
|                                         |                |                          | -act dimension (on 5 act) |                           |         |            |           | act \( r = 0.65 \) |                           | Then rate difficulty with performance |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | Limited testing and use in COPD |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | Developed to measure activity in healthy older adults |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | Activities; work (10 act), yardwork (3 act), caretaking (2 act), exercise (5 act), recreation (7 act) |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | 2 sections to develop 8 indices to determine vigorous, act, low intensity general movement, and time in recreation act |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | May be useful screen of sedentary activities |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | EE and 6MVWT \( r = 0.58, p < 0.01 \) |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | EE and SF36 PF \( r = 0.31, p < 0.01 \) |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | accel \( r = 0.61, p < 0.01 \) |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | Limited use and testing in COPD |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | Weighted scoring |
|                                         |                |                          |                      |                           |         |            |           |                           |                           | Scoring may be cumbersome |

(continued)
| Measure                                      | Activities (#) | Self-/rater-administered | Rating of activities | Time to complete (minutes) | # Items | Time frame | Validity | Reliability | Responsiveness and MCID | Comments |
|----------------------------------------------|----------------|---------------------------|----------------------|----------------------------|---------|------------|----------|-------------|--------------------------|----------|
| Zutphen Physical Activity Questionnaire (ZPAQ) | 27             | SA                        | Yes/no, duration, normal, fast, calm                  | 15 mins                    | 29      | Past week or month (varies with question) | Concurrent | Test–retest $r = 0.87^{112}$ | NA          | Developed to evaluate men longitudinally born 1900-1920. Mets calculated in response to intensity, duration of exercise. $7/27$ act relate to sports or biking. Insensitive to extremely inactive patients. Scoring may be cumbersome. |
### Table 3. Description and psychometric properties of impact measures.

| Measure                                      | Activities (#) | Time to complete (minutes) | Time frame | Validity          | Reliability | Responsiveness and MCID | Comments                                                                 |
|----------------------------------------------|----------------|---------------------------|------------|-------------------|-------------|-------------------------|--------------------------------------------------------------------------|
| Baseline Dyspnea Index/Transitional Dyspnea Index\(^\text{*}\) (BDI/TDI) \(^{18}\) | Variable # 3 categories: magnitude of impairment, effort, and task | 4-5 minutes 3 items | Current Concurrent \(^{114}\) | Test-retest \(r = 0.76\)^\(^{114}\) ICC = 0.90^\(^{115}\) | Internal consistency \(\alpha = 0.80\)^\(^{114}\) MCID | Responsive to PR \(^{116}\) Responsive to treatment \(^{117}\) | • Developed to assess dyspnea in COPD • Initial assessment with BDI, follow-up with TDI for change score • BDI and OCD • \(r = 0.67, p < 0.01\)^\(^{118}\) • BDI and 6MWD • \(r = -0.02, p > 0.05\)^\(^{118}\) • \(r = 0.54, p < 0.001\)^\(^{119}\) • Overlap with Activity Measure |
|                                             | Self-/rater-administered | Rating of activities | # items |                      |             |                         |                                                                          |
| Baseline Dyspnea Index/Transitional Dyspnea Index\(^*\) (BDI/TDI) \(^{18}\) | Variable # 3 categories: magnitude of impairment, effort, and task | Levels of severity 0–4 (0 = most severe) | 4 items |                      |             |                         |                                                                          |
|                                             | RA               | TDI TS = 0–12 |                      |                      |             |                         |                                                                          |
|                                             | SA               | TDI TS = −9 to +9 (0 = no change, +9 = improved) |                      |                      |             |                         |                                                                          |
| London Chest Activity of Daily Living scale\(^*\) (LCADL) \(^{41}\) | SA               | <5 minutes estimate | Past few days | Content \(^{41}\) Construct \(^{41}\) Concurrent \(^{41,120}\) Discriminant \(^{121}\) Convergent \(^{120}\) LCADL | Test-retest ICC = 0.96 Internal consistency \(\alpha = 0.98\)^\(^{41}\) and 0.90^\(^{120}\) | Responsive to PR \(^{103,122}\) MCID = 4 points \(^{123}\) Self-care = 0.9 Domestic = 2.6 Physical = 0.4 Leisure = 0.6 | • Developed to measure dyspnea with routine activities in COPD • Domains: self-care, domestic, physical activity, leisure • 20% ceiling effect on domestic domain \(^{120}\) • CRQ dysp \(r = 0.56, p < 0.001\)^\(^{120}\) • Ped \(r = -0.50, p < 0.01\)^\(^{121}\) • Numerical rating scale @ rest \(r = 0.25, p < 0.05\)^\(^{120}\) • Overlap with Activity Measure |
|                                             | 15               | 15 items |                      |                      |             |                         |                                                                          |
|                                             | 0 = wouldn’t do anyway |                      |          | Content \(^{41}\) Construct \(^{41}\) Concurrent \(^{41,120}\) Discriminant \(^{121}\) Convergent \(^{120}\) LCADL | Test-retest ICC = 0.96 Internal consistency \(\alpha = 0.98\)^\(^{41}\) and 0.90^\(^{120}\) | Responsive to PR \(^{103,122}\) MCID = 4 points \(^{123}\) Self-care = 0.9 Domestic = 2.6 Physical = 0.4 Leisure = 0.6 | • Developed to measure dyspnea with routine activities in COPD • Domains: self-care, domestic, physical activity, leisure • 20% ceiling effect on domestic domain \(^{120}\) • CRQ dysp \(r = 0.56, p < 0.001\)^\(^{120}\) • Ped \(r = -0.50, p < 0.01\)^\(^{121}\) • Numerical rating scale @ rest \(r = 0.25, p < 0.05\)^\(^{120}\) • Overlap with Activity Measure |
|                                             | 1 = no breathlessness |                      |          | Content \(^{41}\) Construct \(^{41}\) Concurrent \(^{41,120}\) Discriminant \(^{121}\) Convergent \(^{120}\) LCADL | Test-retest ICC = 0.96 Internal consistency \(\alpha = 0.98\)^\(^{41}\) and 0.90^\(^{120}\) | Responsive to PR \(^{103,122}\) MCID = 4 points \(^{123}\) Self-care = 0.9 Domestic = 2.6 Physical = 0.4 Leisure = 0.6 | • Developed to measure dyspnea with routine activities in COPD • Domains: self-care, domestic, physical activity, leisure • 20% ceiling effect on domestic domain \(^{120}\) • CRQ dysp \(r = 0.56, p < 0.001\)^\(^{120}\) • Ped \(r = -0.50, p < 0.01\)^\(^{121}\) • Numerical rating scale @ rest \(r = 0.25, p < 0.05\)^\(^{120}\) • Overlap with Activity Measure |
| Measure | Activities (♯) | Self-/rater-administered | Rating of activities | Time to complete (minutes) | # items | Time frame | Validity | Reliability and MCID | Responsiveness and MCID | Comments |
|---------|----------------|--------------------------|----------------------|---------------------------|---------|------------|----------|----------------------|---------------------------|----------|
| Medical Research Council* (MRC)124 | 3 | RA | SA | Grade 0–4 | 1 minute | 1 item | Current Content | ICC 0.82 | 0.83 | Responsiveness is variable for PR 103,126 MCID = 1 point126 | Developed to study respiratory epidemiology. The MRC grading of dyspnea is one segment of a larger questionnaire of 17 questions on symptoms |

- 4/5 activities relate to walking due to breathlessness.
- BDI $r = -0.56$, $p < 0.05$118
- 6MWD $r = 0.52$, $p < 0.001$119
- Poor response to PR may be due to baseline MRC grade.127
- MRC $\geq 3$ sensitive to severe physical activity
- Overlap with Activity and Disability Measures (continued)
Table 3. (continued)

| Measure | Activities (#) | Time to complete (minutes) | Validity | Reliability | Responsiveness and MCID | Comments |
|---------|----------------|---------------------------|----------|-------------|-------------------------|----------|
| Oxygen Cost Diagram<sup>*</sup> (OCD)<sup>53</sup> | 13 RA SA | 0–10 cm vertical line (sleeping to dyspnea with brisk walking uphill). Mark line at point become dyspneic. Activities listed reflect progressive increase in energy expenditure. Score in cm from 0–10. Ability score is distance (cm) from 0 to point marked. | 1 minute 1 item | Current Concurrent<sup>53,118</sup> | Test-retest $r = 0.64$ | Responsiveness unclear<sup>128,129</sup> MCID = NA |
| University of California San Diego Shortness of Breath Questionnaire (UCSD SOBQ)<sup>66</sup> | 21 SA | 0 = not at all breathless 5 = maximum/unable to do activity Scores summed, TS 0–120, high scores worse | 5 minutes (estimate) 24 items | Average over past week Content<sup>66</sup> Construct<sup>114</sup> | Test-retest $r = 0.94^{114}$ ICC = 0.95<sup>115</sup> Internal consistency $\alpha = 0.91^{114}$ | Responsive to PR<sup>131</sup> MCID = 5 points<sup>132</sup> |

MCID: minimal clinically important difference; SA: self-administered; RA: rater-administered; ICC: intra class coefficient; PR: pulmonary rehabilitation; NA: not available; Ped: pedometer.  
<sup>*</sup>Indicate the instrument overlapped with another category.
**Table 4.** Description and psychometric properties of subscales of surrogate measures.*

| Measure                                      | Activities (#) | Self-/rater-administered | Rating of activities | Time to complete (minutes) | Time frame | Validity            | Reliability | Responsiveness and MCID | Comments                                                                 |
|----------------------------------------------|----------------|----------------------------|----------------------|-----------------------------|------------|---------------------|-------------|------------------------|--------------------------------------------------------------------------|
| Clinical COPD Questionnaire* (CCQ)²³        | 5              | RA                         | Rating = 0 (never/not limited) to 6 (almost all the time/totally limited). Low scores better health | 2 minutes 10 items          | Past 7 days | Content²³           | ICC = 0.94³³⁴           | Responsive to smoking cessation³³⁵ PR and exacerbations³³⁶ MCID = 0.4³³⁷ CCQsx = 0.5 CCQf = 0.6 CCQmental = 0.7³³⁸     | Developed to measure health status in COPD Domains: symptoms, functional and mental states. Functional evaluates 4 act Overlaps with Activity and Impact Measures |
|                                              |                | SA                         | CRQ-IA               | 5–10 minutes                | Past 2 weeks | Content²¹, ²²       | ICC = 0.83              | Dysp domain has variable response to PR³³⁹ TS = 5¹⁴⁰ Dysp and CRQdysp = 0.91¹⁴¹ CCQdysp = 0.73–0.95¹⁴⁰ CRQdysp = 0.90¹³³ CRQdysp = 0.53–0.84¹³⁴ | Developed to determine the frequency and importance of areas of dysfunction in resp patients Domains: dysp, fat, emo function, and mastery Dysp domain and symptom of SGRQ r = 0.46 CRQ-SAS act relate to emotions, basic needs, walking, chores, and social¹³⁸ Patients don't often select same act to evaluate dysp on posttest with CRQ-individualized¹³⁹ CRQdysp and SGRQsx r = 0.46, p < 0.01¹⁴¹ TS not well tested¹⁴² Overlaps with Activity and Impact Measures |
| Chronic Respiratory Disease Questionnaire* (CRQ)²¹ CRQ and CRQ used interchangeably | 5              | RA                         | Dysp domain 0 = extremely dyspeic to 7 = not at all. Other domains 1 = maximum to 7 = no impairment Scores: Dysp 1–7 Fat 1–7 Emo 1–7 Mastery 1–7 TS = 20–140 | 5–10 minutes 20 items      | Past 2 weeks | Content²¹, ²²       | ICC = 0.83              | Dysp domain has variable response to PR³³⁹ TS = 5¹⁴⁰ Dysp and CRQdysp = 0.91¹⁴¹ CCQdysp = 0.73–0.95¹⁴⁰ CRQdysp = 0.90¹³³ CRQdysp = 0.53–0.84¹³⁴ | Developed to determine the frequency and importance of areas of dysfunction in resp patients Domains: dysp, fat, emo function, and mastery Dysp domain and symptom of SGRQ r = 0.46 CRQ-SAS act relate to emotions, basic needs, walking, chores, and social¹³⁸ Patients don't often select same act to evaluate dysp on posttest with CRQ-individualized¹³⁹ CRQdysp and SGRQsx r = 0.46, p < 0.01¹⁴¹ TS not well tested¹⁴² Overlaps with Activity and Impact Measures |
| CRQ-IA                                       |                | RA                         | CRQ-IA               | 5–10 minutes                | Past 2 weeks | Content²¹, ²²       | ICC = 0.83              | Dysp domain has variable response to PR³³⁹ TS = 5¹⁴⁰ Dysp and CRQdysp = 0.91¹⁴¹ CCQdysp = 0.73–0.95¹⁴⁰ CRQdysp = 0.90¹³³ CRQdysp = 0.53–0.84¹³⁴ | Developed to determine the frequency and importance of areas of dysfunction in resp patients Domains: dysp, fat, emo function, and mastery Dysp domain and symptom of SGRQ r = 0.46 CRQ-SAS act relate to emotions, basic needs, walking, chores, and social¹³⁸ Patients don't often select same act to evaluate dysp on posttest with CRQ-individualized¹³⁹ CRQdysp and SGRQsx r = 0.46, p < 0.01¹⁴¹ TS not well tested¹⁴² Overlaps with Activity and Impact Measures |
| CRQ-SA                                       |                | SA                         | CRQ-SA               | 5–10 minutes                | Past 2 weeks | Content²¹, ²²       | ICC = 0.83              | Dysp domain has variable response to PR³³⁹ TS = 5¹⁴⁰ Dysp and CRQdysp = 0.91¹⁴¹ CCQdysp = 0.73–0.95¹⁴⁰ CRQdysp = 0.90¹³³ CRQdysp = 0.53–0.84¹³⁴ | Developed to determine the frequency and importance of areas of dysfunction in resp patients Domains: dysp, fat, emo function, and mastery Dysp domain and symptom of SGRQ r = 0.46 CRQ-SAS act relate to emotions, basic needs, walking, chores, and social¹³⁸ Patients don't often select same act to evaluate dysp on posttest with CRQ-individualized¹³⁹ CRQdysp and SGRQsx r = 0.46, p < 0.01¹⁴¹ TS not well tested¹⁴² Overlaps with Activity and Impact Measures |
| CRQ-SR (self-reported)                      |                |                             | CRQ-SR (self-reported) | 5–10 minutes                | Past 2 weeks | Content²¹, ²²       | ICC = 0.83              | Dysp domain has variable response to PR³³⁹ TS = 5¹⁴⁰ Dysp and CRQdysp = 0.91¹⁴¹ CCQdysp = 0.73–0.95¹⁴⁰ CRQdysp = 0.90¹³³ CRQdysp = 0.53–0.84¹³⁴ | Developed to determine the frequency and importance of areas of dysfunction in resp patients Domains: dysp, fat, emo function, and mastery Dysp domain and symptom of SGRQ r = 0.46 CRQ-SAS act relate to emotions, basic needs, walking, chores, and social¹³⁸ Patients don't often select same act to evaluate dysp on posttest with CRQ-individualized¹³⁹ CRQdysp and SGRQsx r = 0.46, p < 0.01¹⁴¹ TS not well tested¹⁴² Overlaps with Activity and Impact Measures |
| CRQ-SAS¹³⁸ = SA and dysp act standardized   |                |                             | CRQ-SAS¹³⁸ = SA and dysp act standardized | 5–10 minutes                | Past 2 weeks | Content²¹, ²²       | ICC = 0.83              | Dysp domain has variable response to PR³³⁹ TS = 5¹⁴⁰ Dysp and CRQdysp = 0.91¹⁴¹ CCQdysp = 0.73–0.95¹⁴⁰ CRQdysp = 0.90¹³³ CRQdysp = 0.53–0.84¹³⁴ | Developed to determine the frequency and importance of areas of dysfunction in resp patients Domains: dysp, fat, emo function, and mastery Dysp domain and symptom of SGRQ r = 0.46 CRQ-SAS act relate to emotions, basic needs, walking, chores, and social¹³⁸ Patients don't often select same act to evaluate dysp on posttest with CRQ-individualized¹³⁹ CRQdysp and SGRQsx r = 0.46, p < 0.01¹⁴¹ TS not well tested¹⁴² Overlaps with Activity and Impact Measures |
| CRQ-SA¹³⁸ = SA (user needs to check how dysp act determined) |                |                             | CRQ-SA¹³⁸ = SA (user needs to check how dysp act determined) | 5–10 minutes                | Past 2 weeks | Content²¹, ²²       | ICC = 0.83              | Dysp domain has variable response to PR³³⁹ TS = 5¹⁴⁰ Dysp and CRQdysp = 0.91¹⁴¹ CCQdysp = 0.73–0.95¹⁴⁰ CRQdysp = 0.90¹³³ CRQdysp = 0.53–0.84¹³⁴ | Developed to determine the frequency and importance of areas of dysfunction in resp patients Domains: dysp, fat, emo function, and mastery Dysp domain and symptom of SGRQ r = 0.46 CRQ-SAS act relate to emotions, basic needs, walking, chores, and social¹³⁸ Patients don't often select same act to evaluate dysp on posttest with CRQ-individualized¹³⁹ CRQdysp and SGRQsx r = 0.46, p < 0.01¹⁴¹ TS not well tested¹⁴² Overlaps with Activity and Impact Measures |
| Measure | Activities (#) | Self-/rater-administered | Rating of activities | Time to complete (minutes) | # items | Time frame | Validity | Reliability | Responsiveness and MCID | Comments |
|---------|---------------|---------------------------|---------------------|---------------------------|---------|------------|----------|-------------|--------------------------|----------|
| EuroQol* (EQ-5D-5 L)28,29 | 3 | SA | Rating of each activity/dimension on 5 levels of severity: no problem to extreme problems. Ratings converted to Index Value of 0–1 | 5 minutes (estimate) | 5 items | Today | Content28 | Test–retest k 95% CI 0.69 mobility, 0.64 activity148 ICC 0.75148 NA | Responsive to PR149 | Measure of health status |
| EQ VAS | 1 | RA | Rating 0 = worse imaginable health 100 = best imaginable health Scoring 0–100 on vertical 20 cm VAS | 1 minute 1 item | 1 item | Today | Today | Content29,148 Construct29,148 Discriminant149 Convergent148 | Responsiveness and MCID MCID = 0.05149 MCID = 7149 | 2 parts, the EQ-5D-5 L and EQ VAS Act/dimension: mobility, self-care, usual act, pain/discomfort, anxiety/depression |
| St. George's Respiratory Questionnaire* (SGRQ)61 | 14 | SA | Scoring each domain 0–100 TS = 0–100 (high scores worse) | 10 minutes 56 items | Current and past 4 weeks | Content61 Construct61, 150 | Test–retest (2 weeks) ICC = total score 0.92 and 0.87 on activity domain61 Internal consistency α = 0.83 activity151 | Responsive to: PR103,131 exacerbations146,152 and pharmacology tx153 MCID = 4 points per domain and 7 with PR137 IPF sx = 8 act = 5 impact = 7 TS = 7154 | Overlaps with Activity and Impact Measures |

- Measure of health status
- 2 parts, the EQ-5D-5 L and EQ VAS
- Act/dimension: mobility, self-care, usual act, pain/discomfort, anxiety/depression
- Scoring does not separate act from emotion and pain rating
- Relation to SGRQ act r = −0.60, p < 0.001; CRQdys r = 0.40, p < 0.001; CCQFunc r = −0.67, p < 0.001149
- Weighted scoring
- Overlaps with Activity Measure
- Developed to measure health status in respiratory patients
- Domains: act, symp, impact
- TS 6MWD r = −0.56, p < 0.00135
- Items are weighted
- Overlaps with Activity and Impact Measures

(continued)
Table 4. (continued)

| Measure                                | Activities (#) | Rating of activities | Time to complete (minutes) | Time frame | Validity       | Reliability | Responsiveness and MCID | Comments                                                                 |
|----------------------------------------|----------------|----------------------|----------------------------|------------|----------------|-------------|------------------------|--------------------------------------------------------------------------|
| Medical Outcomes Study* (SF-36)62      | 10 on Physical Function scale | Limited a lot, a little, not limited at all on activity | 5–10 minutes | Current Content69,155,156 | Test–retest ≥ 0.90 physical scale155 | PCS responsive to PR131 MCID ILD 3–5154 | Developed to survey health                                               |
|                                        | SA             | TS = 0–100 (low more limitation) | 36 items                  |            |                |             | Physical function scale and physical component score (PCS) often used for comparison as physical function standard | Scales (8): physical, social, mental health, vitality, pain, general health, and so on |
|                                        |                |                      |                            |            |                |             | PCSs are scores from PF, role physical, pain, and general health | Overlaps with Activity Measure                                           |

COPD: chronic obstructive pulmonary disease; MCID: minimal clinically important difference; SA: self-administered; RA: rater-administered; ICC: intra class coefficient; PR: pulmonary rehabilitation; act: activities; dysp: dyspnea; VAS: visual analog scale; CI: confidence interval; NA: not available; TS: total score; ILD: interstitial lung disease; PCS: physical component score; PF: physical function

*Overlap with another category. The domains representing activity levels (e.g. dyspnea, physical function) were reported: CRQ: dyspnea; CCQ: functional state; SGRQ: activity; SF36: physical function scales.
| Measure | Activities (#) | Self-/rater-administered | Rating of activities | Time to complete (minutes) | Time frame | Validity | Reliability | Responsiveness and MCID | Comments |
|---------|----------------|--------------------------|----------------------|---------------------------|------------|----------|-------------|------------------------|----------|
| Glittre-ADL Test\footnote{35} | 4 | RA | 4 activities constituting a “lap” Scoring: time spent to complete laps in minutes | <10 minutes | Current Content\textsuperscript{35} Concurrent\textsuperscript{35} Discriminant\textsuperscript{157,158} | Test–retest @24 hours = 0.93\textsuperscript{35} | Responsive to pulmonary rehabilitation\textsuperscript{35} MCID = NA | - Developed to measure functional status in COPD with standardized ADL-like activities - Backpack (2.5 kg/women, 5 kg/men) carried during activity - Complete 5 laps as fast as possible, rest if needed - 6MWD - \( r = -0.82, p < 0.001 \textsuperscript{35} \) - \( r = -0.87, p < 0.01 \textsuperscript{159} \) - \( \text{VO}_2 \ r = 0.87, p < 0.05 \textsuperscript{159} \) - May not be responsive to upper extremity exercise\textsuperscript{76} |
| Londrina Activity of Daily Living Protocol (LAP)\textsuperscript{43} | 5 | RA | Total seconds to complete 5 tasks | 7 minutes | Current Content\textsuperscript{43} Concurrent\textsuperscript{43,160} ICC = >0.94\textsuperscript{43} 0.91\textsuperscript{160} | NA | - Developed to assess upper and lower extremities and trunk activities - Assesses ADL performance in COPD - 5 stations demonstrating upper, lower extremity, trunk flexion/rotation/inclination - Complete at own pace, rest as needed 6MWD \( r = -0.53 \textsuperscript{160} \) |
| Monitored Functional Task Evaluation (MFTE)\textsuperscript{50} | 5 | | 5 tasks each done within 2 minutes. Scoring 0–4 each task Scoring 0–20 for overall performance | 15–20 minutes | Current Content\textsuperscript{50} Concurrent\textsuperscript{50} ICC = 0.82\textsuperscript{50} | Test–retest qigong added to PR\textsuperscript{161} MCID = NA | Responsive to qigong added to PR\textsuperscript{161} MCID = NA | - Developed to evaluate physical components contributing to occupational performance in COPD with moderate–severe disease - 5 tasks: walk, sit–stand, lift, walk carrying load - Done at usual pace - Scores transformed - 6MWD \( r = 0.32, p \leq 0.01 \textsuperscript{50} \) - CRQdysp \( r = 0.18, p > 0.05 \textsuperscript{50} \) - Limited testing in COPD |

MCID: minimal clinically important difference; NA: not available; COPD: chronic obstructive pulmonary disease; ICC: intra class coefficient; RA: rater-administered.
Table 6. Description and psychometric properties of disability-based measures.

| Measure                  | Activities (#) | Self-/rater-administered | Rating of activities | Time to complete (minutes) | Time frame | Validity | Reliability | Responsiveness and MCID |Comments |
|--------------------------|----------------|---------------------------|----------------------|---------------------------|------------|----------|-------------|-------------------------|---------|
| Barthel Index (BI)\(^\text{16}\) | 10             | SA                        | Rating varies with item and study (0, 5; 0, 5, 10; and 0, 5, 10, 15): | Current | Concurrent\(^\text{163}\) | NA in COPD | Responsiveness not available in COPD | • Developed to evaluate independence in frail elderly and stroke |         |
|                          |                | RA                        | <5 minutes SA 20 minutes RA 10 items |                | Discriminant with pneumonia\(^\text{164}\) |           | MCID = 4.02 pts. In chronic stroke\(^\text{165}\) | • NEADL has greater sensitivity (76% vs 19%) than Barthel\(^\text{4}\) for differentiating elderly with respiratory disability |         |
|                          |                |                           |                       |                           |            |          | a = 0.90\(^\text{17}\) | NA in COPD | • BI and MRC \(r = 0.53, p < 0.001\)\(^\text{163}\) |         |
|                          |                |                           |                       |                           |            |          |             | Good psychometrics among acute and chronic stroke |         |
|                          |                |                           |                       |                           |            |          |             | Limited testing and use in COPD |         |
| BI modified (BIM)\(^\text{17}\) | 10             | SA                        | Coding of original act as 1–5 | Current | NA | Internal consistency \(\alpha = 0.90\)\(^\text{17}\) | NA respiratory patients | • Modified scoring metric 0–4 = very severely disabled |         |
|                          |                | RA                        | 5             | Current | NA | | | 5–9 = severely |         |
|                          |                |                           | 10            | Current | NA | | | 10–14 = moderately |         |
|                          |                |                           | 0–100           | Current | NA | | | 15–19 = mildly disabled |         |
|                          |                |                           |                |                           |            |          |             | 20 = independent |         |
|                          |                |                           |                |                           |            |          |             | Items are weighted |         |
|                          |                |                           |                |                           |            |          |             | No known use in COPD |         |

(continued)
| Measure                                           | Activities (#) | Time to complete (minutes) | Time frame | Validity         | Reliability          | Responsiveness and MCID | Comments                                                                 |
|--------------------------------------------------|----------------|----------------------------|------------|------------------|----------------------|--------------------------|--------------------------------------------------------------------------|
| Groningen Activity Restriction Scale (GARS)³⁶     | 18 SA          | NA                         | Past week  | Content³⁶        | Internal consistency | NA                       | • Developed to assess disability in domains of personal care and domestic activities |
|                                                  |                |                            | 18 items   | Construct³⁶      | 0.94                 |                          | • Activities: grooming, feeding self                                     |
|                                                  |                |                            |            | Concurrent³⁶,166 |                      |                          | • GARS and 6MWD $r = 0.77^{168}$                                         |
|                                                  |                |                            |            | Discriminant³⁶   |                      |                          | • $r = 0.53$ with steps¹⁶⁶                                              |
|                                                  |                |                            |            |                  |                      |                          | • GARS and SF36 PF $r = 0.48$, $p < 0.01$                                 |
|                                                  |                |                            |            |                  |                      |                          | • CCQ Funct $r = -0.51$, $p < 0.01$                                      |
|                                                  |                |                            |            |                  |                      |                          | • SGRQ act $r = -0.57$, $p < 0.01$                                       |
|                                                  |                |                            |            |                  |                      |                          | • If don’t engage in act, asked to “imagine” if they could               |
| Manchester Respiratory Activity of Daily Living   | 21 SA          | Ability to perform         | Current    | Discriminant⁴⁴  | ICC 0.92 and 0.86    | Responsive to PR⁴⁴ MCID NA | • Developed to evaluate disability in elderly with COPD                   |
| Questionnaire (MRADL)⁴⁴                         |                | 0 = not at all or with help|            |                  |                      |                          | • Domains: mobility, kitchen, domestic tasks, and leisure                |
|                                                  |                | 1 = alone with difficulty  |            |                  |                      |                          | • Limited testing                                                        |
|                                                  |                | or alone easily            |            |                  |                      |                          |                                                                          |
|                                                  |                | Scoring 0–21 (no impairment)|            |                  |                      |                          |                                                                          |
| Nottingham Extended Activities of Daily Living    | 22 SA          | Rate performance from 0 =  | Past week  | Content³       | ICC 0.89¹⁷¹          | Not tested in COPD MCID = 6.0¹⁷¹ | • Developed to assess stroke patients via mail                           |
| Questionnaire (NEADL)³                           |                | not perform or with help   |            | Concurrent¹⁷⁰   |                      |                          | • Sections: mobility, kitchen, domestic, and leisure activity             |
|                                                  |                | 1 = on my own with difficulty or on my own | | Discriminant⁴,4⁷ |                      |                          | • Greater sensitivity than Barthel³                                      |
|                                                  |                | Score 0–22 (high score, more independent) | |                  |                      |                          | • Limited use and testing in COPD                                         |

MCID: minimal clinically important difference; SA: self-administered; RA: rater-administered; TS: total score; NA: not available; COPD: chronic obstructive pulmonary disease; ICC: intra class coefficient.
Table 7. Listing of FSMs by categories and identifying categories with which they overlap.

| Measuresa | Categories |
|-----------|------------|
| ACT IMP SURR DIS PB |
| **Activity (ACT)** |
| CHAMPS25 | | | X | | |
| COPM73 | | | | | |
| DASI27 | | | | | |
| FPI32 | | | | | |
| FPI-SF33 | | | | | |
| HAP57 | | | | | |
| MAS48 | | | | | |
| PAR63 | | | | | |
| PASE55 | | | | | |
| PFSS57 | | | X | | |
| PFSS-3557 | | | X | | |
| PFSDQ59 | | | | | |
| PFSDQ-M60 | | | | | |
| ProActive56 | | | | | |
| VLA64 | | | | | |
| YPAS67 | | | | | |
| ZPAQ68 | | | | | |
| **Impact (IMP)** |
| BDI18 | X | | | | |
| LCADL41 | X | | | | |
| MRC46 | X | | | | |
| OCD53 | X | | | | |
| SOBQ66 | X | | | | |
| **Surrogate (SURR)** |
| CCQ23 | X | X | | | |
| CRQ21 | X | X | | | |
| EuroQOL-ED 5D-5 L28 | X | | X | | |
| SGRQ61 | X | X | | | |
| SF-362 | X | | | | |
| **Performance-Based (PB)** |
| Glittre Test35 | | | | | |
| LAP43 | | | | | |
| MFTE50 | | | | | |
| **Disability (DIS)** |
| B116 | | | | | |
| BIM17 | | | | | |
| GARS36 | | | | | |
| MRADL14 | | | | | |
| NEADL3 | | | | | |

FSM: functional status measure. Shaded columns indicate the activities within the respective categories.

aRefer to Table 1 for abbreviations of FSMs.

clinical and research objectives. Considering the diversity of measures available for use, selection must
be thoughtful based on the nature of the population being studied, and evaluation being conducted, not
simply used because it is a standard at the institution. The options are varied and may be overwhelming.
Through categorizing the FSMs and providing a summary of design and psychometric properties of the
measures, this article aims to guide clinicians and researchers alike in the selection of the most appro-
priate measure for their situation.

While measuring functional status is a complex construct, not all measures could be easily categor-
ized into one theme. We found measures that overlap between categories. Further, some aspects of FSMs
may not be considered “activity measures” by some. For example, the chronic respiratory disease question-
aire (CRQ)22 dyspnea domain can be considered an “impact” measure, as this most closely measures
function in the CRQ (see Surrogate category). On the other hand, the Saint George’s Respiratory Question-
naire (SGRQ),61 also a health status measure, has an “activity” as well as a symptom domain. However,
this domain queries about many symptoms, not only dyspnea with an activity. Arguably, the dyspnea
domain of the CRQ could be an Impact-Based Measure because it asks patients to rate the severity of
their dyspnea with each activity. However, because it is a subscale of the CRQ, we determined it best fit
with other Surrogate Measures. On the other hand, the Medical Research Council Modified version
(mMRC) with 5 grades (0–4)46,172 has been used as both a measure of dyspnea and disability.47,95 While
more commonly known as a dyspnea measure, the mMRC evaluates the impact of dyspnea on activity
levels (primarily walking) and therefore meets our criteria for an Impact-Based Measure. However, the
mMRC could also arguably be justified as a disability measure because the grades provide a distinct indication
of impairment, that is, activity limitation (breathlessness only with strenuous exercise) to severe
limitation (too breathless to leave the home). In interpreting the categorization, clinicians and researchers
therefore may select an FSM based on the overlap. This could be of particular use when more than one
domain or construct is to be measured, saving patients time in completing only one tool instead of multiple.
While the creation of this framework and categorization of FSMs has attempted to simplify selection of
instruments, extensive consideration by clinicians and researchers alike is still needed prior to selection of an
FSM to ensure that the most efficient and targeted tool is indeed selected.
Psychometric testing is a critical feature to a strong instrument and issues of reliability, validity, and responsiveness should have been demonstrated, and through this review a summary of these properties has been synthesized for clinicians to access. Where psychometric properties of an instrument are not available in the literature, further research should be completed prior to clinical application of the tool. The framework presented in this article provides information only on tools that have been assessed, and therefore, this article is intended as one of many resources for clinicians to draw on.

The available FSMs to date have predominantly been developed and evaluated in English language countries with European-based cultures, and this should be considered when selecting a measure. Some activities identified in the original development of the instruments may not be relevant for some countries/cultures/genders/age groups. For example, FSMs containing activities such as soccer, shoveling snow, and ice skating may not be relevant to certain areas of the world or to the elderly individual with moderate to severe disease. Further, some instruments used gender-specific terms or stereotypes to describe activities. This may result in significant missing data. In the development of an instrument, there should be virtually no missing data (i.e. the instrument must make allowances for activities never performed, unrelated to COPD). On the other hand, if a study finds missing data occurring, they should be vigilant for the reasons for lack of response. For culturally responsive and adaptable health-care practice, ethnocultural interpretation of the measures should be evaluated prior to selection for application, and research into application of the FSMs to broader diverse communities is needed.

In evaluation of reading level of FSMs included in this review, most instruments attempt to attain reading at the 5th or 6th grade reading level (although not always stated); however, the nature of terms used in health care (e.g. breathlessness) may result in higher than desirable reading levels and may impact the psychometric properties of the FSMs. Understanding the reading and health literacy of the population group should also be a factor in selecting an instrument. Health literacy is the level to which an individual has the capacity to obtain, process, and understand basic health information and health-care services available to make informed decisions on health-care management. Low levels of health literacy are readily reported for people with COPD and are linked to poorer health outcomes. Cognitive capacity may also impact the ability to complete the FSM. The incidence of cognitive impairment for people with COPD is greater than the general population with structural brain abnormalities, such as decreased hippocampal volume, increased deep or infratentorial microbleeds, and white matter lesions, being more frequently evident. When measuring functional status, should the patient’s reading, cognitive, and literacy level be below that required, this could significantly impact the psychometric properties of the tool and lead to inaccurate information and conclusions. Further, research in understanding the impact of reading or literacy levels on the psychometric properties of FSMs is warranted to ensure that the tools are valid and reliable across different cultural groups.

Conclusions

A diverse range of measures are available to the clinician and researcher looking to evaluate functional status for people with COPD. The establishment of the many FSMs is likely related to the numerous reasons for why functional status is measured for people with COPD. Considering the diversity of measures available for use, selection must be thoughtful based on the nature of the population being studied, and evaluation being conducted, not simply because it is a standard at the institution. Psychometric testing is a critical feature to a strong instrument and issues of reliability, validity, and responsiveness need to be understood prior to measurement use. Contextual nature of measures such as language used and activities measured is also important. One approach to categorizing FSMs was presented to include daily activities measures, impact measures, surrogate measures, indirect performance-based measures, and disability-based measures. A summary of design and psychometric properties of the measures was provided as a guide to clinicians and researchers in the selection of the most appropriate application of a measure.

Authors’ note

Portions of this article were presented at the International Conference of the American Thoracic Society, Washington, DC, USA, May 2017.

Declaration of conflicting interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or
publication of this article: SL is developer of the PFSDQ and PFSDQ-M referred to in this article.

Funding
The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD
Suzanne C Lareau  https://orcid.org/0000-0001-9491-1769

References
1. Gimeno-Santos E, Raste Y, Demeyer H, et al. The PROactive instruments to measure physical activity in patients with chronic obstructive pulmonary disease. *Eur Respir J* 2015; 46(4): 988–1000.
2. Pitta F, Troosters T, Probst VS, et al. Quantifying physical activity in daily life with questionnaires and motion sensors in COPD. *Eur Respir J* 2006; 27: 1040–1055.
3. Nouri FM and Lincoln NB. An extended activity of daily living scale for stroke patients. *Clin Rehabil* 1987; 1: 301–305.
4. Yohannes AM, Roomi J, Waters K, et al. A comparison of the Barthel index and Nottingham extended activities of daily living scale in the assessment of disability in chronic airflow limitation in old age. *Age Ageing* 1997; 27: 369–374.
5. 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.
6. Liu Y, Li H, Ding N, et al. Functional status assessment of patients with COPD: a systematic review of performance-based measures and patient-reported measures. *Medicine (Baltimore)* 2016; 95: e3672.
7. Janaudis-Ferreira T, Beauchamp MK, Robles PG, et al. Measurement of activities of daily living in patients with COPD: a systematic review. *Chest* 2014; 145: 253–271.
8. Arbuckle TY, Gold DP, Chaikelson JS, et al. Measurement of activity in the elderly: the activities checklist. *Can J Aging* 1994; 13: 550–565.
9. Holbrook M and Skilbeck CE. An activities index for use with stroke patients. *Age Ageing* 1983; 12: 166–170.
10. So CT and Man DWK. Development and validation of an activities of daily living inventory for the rehabilitation of patients with chronic obstructive pulmonary disease. *OTJR (Thorofare N J)* 2008; 28: 149–159.
11. Ogden LD and Derenne C. *Chronic obstructive pulmonary disease: program guidelines for occupational therapists and other health professionals*. Laurel: Ramsco Publishing, 1985.
12. Neistadt ME and Crepeau EB. *Willard and Sparkman’s occupational therapy*. 9th ed. Philadelphia: Lippincott, Williams & Wilkins, 1997.
13. Ries AL, Ellis B, and Hawkins RW. Upper extremity exercise training in chronic obstructive pulmonary disease. *Chest* 1988; 93: 688–692.
14. Clark MS and Bond MJ. The Adelaide Activities Profile: a measure of the lifestyle activities of elderly people. *Aging (Milano)* 1995; 7: 174–184.
15. Baecke JAH, Burema J, and Frijters ER. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. *Am J Clin Nutr* 1982; 36: 936–942.
16. Mahoney FI and Barthel DW. Functional evaluation of the Barthel index. *MD State Med J* 1965; 14: 61–65.
17. Shah S, Vanclay F, and Cooper B. Improving the sensitivity of the Barthel Index for stroke rehabilitation. *J Clin Epidemiol* 1989; 42: 703–709.
18. Mahler DA, Weinberg DH, Wells CK, et al. The measurement of dyspnea: contents, interobserver agreement, and physiologic correlates of two new clinical indexes. *Chest* 1984; 85: 751–758.
19. Law M, Baptiste S, McColl M, et al. The Canadian occupational performance measure: an outcome measure for occupational therapy. *Can J Occup Ther* 1990; 57: 82–87.
20. Partridge MR, Miravitlles M, Ståhl E, et al. Development and validation of the capacity of daily living during the morning questionnaire and the global chest symptoms questionnaire in COPD. *Eur Respir J* 2010; 36: 96–104.
21. Guyatt GH, Berman LB, Townsend M, et al. A measure of quality of life for clinical trials in chronic lung disease. *Thorax* 1987; 42: 773–778.
22. Guyatt GH, Townsend M, Berman LB, et al. Quality of life in patients with chronic airflow limitation. *Br J Dis Chest* 1987; 81: 45–54.
23. van der Molen T, Willemse BWM, Schokker S, et al. Development, validity and responsiveness of the Clinical Copd Questionnaire. *Health Qual Life Outcomes* 2003; 1: 1–10.
24. Morimoto M, Takai K, Nakajima K, et al. Development of the chronic obstructive pulmonary disease activity rating scale: reliability, validity and factorial structure. *Nurs Health Sci* 2003; 5: 23–30.
25. Stewart AL, Mills KM, Sepsis P, et al. Evaluation of CHAMPS, a physical activity promotion program for older adults. Ann Behav Med 1997; 19: 353–361.
26. Dallosso HM, Morgan K, Bassey EJ, et al. Levels of customary physical activity among the old and the very old living at home. J Epidemiol Community Health 1988; 42: 121–127.
27. Hlatky MA, Boineau RE, Higginbotham MB, et al. A brief self-administered questionnaire to determine functional capacity (the Duke Activity Status Index). Am J Cardiol 1989; 64: 651–654.
28. Herdman M, Gudex C, Lloyd A, et al. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5 L). Qual of Life Res 2011; 20: 1727–1736.
29. The EuroQol Group. EuroQol—a new facility for the measurement of health-related quality of life. Health Policy 1990; 16: 199–208.
30. Reisberg B. Functional assessment staging (FAST). Psychopharmacol Bull 1988; 24: 653–659.
31. Pfeffer RI, Kurosaki TT, Harrah CJ Jr., et al. Measurement of functional activities in older adults in the community. J Gerontol 1982; 37: 323–329.
32. Leidy NK. Psychometric properties of the functional performance inventory in patients with chronic obstructive pulmonary disease. Nurs Res 1999; 48: 20–28.
33. Leidy NK, Hamilton A, and Becker K. Assessing patient report of function: content validity of the Functional Performance Inventory-Short Form (FPI-SF) in patients with chronic obstructive pulmonary disease (COPD). Int J Chron Obstruct Pulmon Dis 2012; 7: 543–544.
34. Jette AM, Davies AR, Cleary PD, et al. The Functional Status Questionnaire: reliability and validity when used in primary care. J Gen Intern Med 1986; 1: 143–149.
35. Skumlien S, Hagelund T, Bjørtuft O, et al. A field test of functional status as performance of activities of daily living in COPD patients. Respir Med 2006; 100: 316–323.
36. Kempen GI, Miedema I, Ormel J, et al. The assessment of disability with the Groningen Activity Restriction Scale. Conceptual framework and psychometric properties. Soc Sci Med 1996; 43: 1601–1610.
37. Fix AJ and Daughton DM. Human activity profile professional manual. Odessa: Psychological Assessment Resources Inc., 1988.
38. Katz S, Ford AB, Moskowitz RW, et al. Studies of illness in the aged. The index of ADL: a standardized measure of biological and psychosocial function. JAMA 1963; 185: 914–919.
39. Lawton MP and Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. Gerontologist 1969; 9: 179–186.
40. Mor V, Laliberte L, Morris JS, et al. The Karnofsky performance status scale: an examination of its reliability and validity in a research setting. Cancer 1984; 53: 2002–2007.
41. Garrod R, Bestall JC, Paul EA, et al. Development and validation of a standardized measure of activity of daily living in patients with severe COPD: the London Chest Activity of Daily Living scale (LCADL). Respir Med 2000; 94: 589–596.
42. Harwood RH, Rogers A, Dickenson E, et al. Measuring handicap: the London Handicap Scale, a new outcome measure for chronic disease. Qual Health Care 1994; 3: 11–16.
43. Sant’Anna T, Donarria L, Furlanetto KC, et al. Development, validity and reliability of the Londrina Activities of Daily Living Protocol for subjects with COPD. Respir Care 2017; 62: 288–297.
44. Yohannes AM, Roomi J, Winn S, et al. The Manchester Respiratory Activities of Daily Living questionnaire: development, reliability, validity, and responsiveness to pulmonary rehabilitation. J Am Geriatr Soc 2000; 48: 1496–1500.
45. Eakman AM, Carlson ME, and Clark FA. The Meaningful Activity Participation Assessment: a measure of engagement in personally valued activities. Int J Aging Hum Dev 2010; 70: 299–317.
46. Fletcher CM. The clinical diagnosis of pulmonary emphysema—an experimental study. Proc R Soc Med 1952; 45: 577–584.
47. Bestall JC, Paul EA, Garrod R, et al. Usefulness of the Medical Research Council (MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. Thorax 1999; 54: 581–586.
48. Seaton MK, Groth GN, Matheson L, et al. Reliability and validity of the Milliken Activities of Daily Living Scale. J Occup Rehabil 2005; 15: 343–351.
49. Taylor HL, Jacobs DR Jr., Schucker B, et al. A questionnaire for the assessment of leisure time physical activities. J Chronic Dis 1978; 31: 741–755.
50. Fong KNK, Ng BHB, Chow KKY, et al. Reliability and validity of the monitored functional task evaluation (MFTE) for patients with chronic obstructive pulmonary disease (COPD). Hong Kong J Occup Th 2001; 11: 10–17.
51. Dodds TA, Martin DP, Stolov WC, et al. A validation of the functional independence measurement and its performance among rehabilitation inpatients. Arch Phys Med Rehab 1993; 74: 531–536.
52. Yoza Y, Ariyoshi K, Honda S, et al. Development of an activity of daily living scale for patients with COPD: the Activity of Daily Living Dyspnea scale. Respirology 2009; 14: 429–435.
53. McGavin CR, Artvinli M, Naoe H, et al. Dyspnoea, disability, and distance walked: comparison of estimates of exercise performance in respiratory disease. Br Med J 1978; 2: 241–243.
54. Morley D, Dummett S, Kelly L, et al. Validation of the Oxford participation and activities questionnaire. Patient Relat Outcome Meas 2016; 7: 73–80.
55. Washburn RA, Smith KW, Jette AM, et al. The physical activity scale for the elderly (PASE): development and evaluation. J Clin Epidemiol 1993; 46: 153–162.
56. Dobbels F, de Jong C, Drost E, et al. The PROactive innovative conceptual framework on physical activity. Eur Respir J 2014; 44: 1223–1233.
57. Weaver TE and Narsavage GL. Physiological and psychological variables related to functional status in chronic obstructive pulmonary disease. Nurs Res 1992; 41: 286–291.
58. Chen YJ, Narsavage GL, Culp SL, et al. The development and psychometric analysis of the short-form pulmonary functional status scale (PFSS-11). Res Nurs Health 2010; 33: 477–485.
59. Lareau SC, Carrieri-Kohlman V, Janson-Bjerklie S, et al. Development and testing of the Pulmonary Functional Status and Dyspnea Questionnaire (PFSDQ). Heart Lung 1994; 23: 242–250.
60. Lareau SC, Meek PM, and Roos PJ. Development and testing of a modified version of the Pulmonary Functional Status and Dyspnea Questionnaire (PFSDQ-M). Heart Lung 1998; 27: 159–168.
61. Jones PW, Quirk FH, Baveystock CM, et al. A self-complete measure for chronic airflow limitation: the St George’s respiratory questionnaire. Am Rev Respir Dis 1992; 145: 1321–1327.
62. Ware JE. SF-36 health survey: manual and interpretation guide. Boston: The Health Institute, New England Medical Center, 1993.
63. Blair SN, Haskell WL, Ho P, et al. Assessment of habitual physical activity by a seven-day recall in a community survey and controlled experiments. Am J Epidemiol 1985; 122: 794–804.
64. Katz PP, Morris A, and Yelin EH. Prevalence and predictors of disability in valued life activities among individuals with rheumatoid arthritis. Ann Rheum Dis 2006; 65: 763–769.
65. McGee MA, Johnson AL, Kay DWK, et al. The description of activities of daily living in five centres in England and Wales. Age Ageing 1998; 27: 605–613.
66. Archibald CJ and Guidotti TL. Degree of objectivity measured impairment and perceived shortness of breath with activities of daily living in patients with chronic obstructive pulmonary disease. Can J Rehabil 1987; 1: 45–54.
67. DiPietro I, Caspersen C, Ostfeld A, et al. A survey for assessing physical activity among older adults. Med Sci Sports Exerc 1993; 25: 628–642.
68. Caspersen CJ, Bloember BPM, Saris WHM, et al. The prevalence of selected physical activities and their relation with coronary heart disease risk factors in elderly men: the Zutphen study, 1985. Am J Epidemiol 1991; 133: 1078–1092.
69. Ware JEJ and Sherbourne CD. The MOS 36-item short-form health survey (SF-36): I. Conceptual framework and item selection. Med Care 1992; 30: 473–483.
70. Stewart AL, Mills KM, King AC, et al. CHAMPS physical activity questionnaire for older adults: outcomes for interventions. Med Sci Sports Exerc 2001; 33: 1126–1141.
71. Harada ND, Chiu V, King AC, et al. An evaluation of three self-report physical activity instruments for older adults. Med Sci Sports Exerc 2001; 33: 962–970.
72. Eyssen ICJM, Steultjens PM, Oud TAM, et al. Responsiveness of the Canadian occupational performance measure. J Rehabil Res Dev 2011; 48: 517–528.
73. Law M, Polatajko H, Pollock N, et al. Pilot testing of the Canadian occupational performance measure: clinical and measurement issues. Can J Occup Ther 1994; 61: 191–197.
74. Sewell L and Singh S. The Canadian occupational performance measure: is it a reliable measure in clients with chronic obstructive pulmonary disease? Br J Occup Ther 2001; 64: 305–310.
75. Sewell L, Singh SJ, Williams JEA, et al. Can individualized rehabilitation improve functional independence in elderly patients with COPD? Chest 2005; 128: 1194–1200.
76. Calik-Kutukcu E, Arikan H, Saglam M, et al. Arm strength training improves activities of daily living and occupational performance in patients with COPD. Clin Respir J 2015; 11: 820–832.
77. Martinsen U, Bentzen H, Holter MK, et al. The effect of occupational therapy in patients with chronic obstructive pulmonary disease: a randomized controlled trial. Scand J Occup Ther 2017; 24: 89–97.
92. Miller DJ, Freedson PS, and Kline GM. Comparison of clinical and angiographic factors to functional capacity as measured by the Duke Activity Status Index. *Am J Cardiol* 1991; 68: 973–975.
93. Garfield BE, Canavan JL, Smith CJ, et al. Stanford seven-day physical activity recall questionnaire in COPD. *Eur Respir J* 2012; 40: 356–362.
94. Sallis JF, Haskell WL, Wood PD, et al. Physical activity assessment methodology in the Five-City Project. *Am J Epidemiol* 1985; 121: 91–106.
95. dePew ZS, Garofoli AC, Novotny PJ, et al. Screening for severe physical inactivity in chronic obstructive pulmonary disease: the value of simple measures and the validation of two physical activity questionnaires. *Chron Respir Dis* 2013; 10: 19–27.
96. Gosker HR, Lencer NHMK, Franssen FME, et al. Striking similarities in systemic factors contributing to decreased exercise capacity in patients with severe chronic heart failure or COPD. *Chest* 2003; 123: 1416–1424.
97. Bowen JB, Votto JJ, Thrall RS, et al. Functional status and survival following pulmonary rehabilitation. *Chest* 2000; 118: 697–703.
98. Weaver TE, Narsavage GL, and Guilfoyle MJ. The development and psychometric evaluation of the Pulmonary Functional Status Scale: an instrument to assess functional status in pulmonary disease. *J Cardiopulm Rehabil* 1998; 18: 105–111.
99. Ramachandran K, McCusker C, Connors M, et al. The influence of obesity on pulmonary rehabilitation outcomes in patients with COPD. *Chron Respir Dis* 2008; 5: 205–209.
100. Kovelis D, Segretti NO, Probst VS, et al. Validation of the Modified Pulmonary Functional Status and Dyspnea Questionnaire and the Medical Research Council scale for use in Brazilian patients with chronic obstructive pulmonary disease. *J Bras Pneumol* 2008; 34: 1008–1018.
101. Regueiro EMG, Burtin C, Baten P, et al. The minimal important difference of the Pulmonary Functional Status and Dyspnea Questionnaire in patients with severe chronic obstructive pulmonary disease. *Respir Res Open Access* 2013; 14: 58.
102. Zhan S, Cerny FJ, Gibbons WJ, et al. Development of an unsupported arm exercise test in patients with chronic obstructive pulmonary disease. *J Cardiopulm Rehabil* 2006; 26: 180–187.
103. Kovelis D, Zabatiero J, Oldemberg N, et al. Responsiveness of three instruments to assess self-reported functional status in patients with COPD. *Int J COPD* 2011; 8: 334–339.
104. Janssens T, DePeuter S, Stans L, et al. Dyspnea perception in COPD. *Chest* 2011; 140: 618–625.
105. Trappenburg JC, Troosters T, Spruit MA, et al. Psychosocial conditions do not affect short-term outcome
of multidisciplinary rehabilitation in chronic obstructive pulmonary disease. Arch Phys Med Rehabil 2005; 86: 1788–1792.

106. Belza B, Steele BG, Hunziker J, et al. Correlates of physical activity in chronic obstructive pulmonary disease. Nurs Res 2001; 50: 195–202.

107. Yelin E, Lubeck D, Holman H, et al. The impact of rheumatoid arthritis and osteoarthritis: the activities of patients with rheumatoid arthritis and osteoarthritis compared to controls. J Rheumatol 1987; 14: 710–717.

108. Katz P, Chen H, Omachi TA, et al. The role of physical inactivity in increasing disability among older adults with obstructive airway disease. J Cardiopulm Rehabil Prev 2011; 31: 193–197.

109. Katz PP, Gregorich S, Eisner M, et al. Disability in valued life activities among individuals with COPD and other respiratory conditions. J Cardiopulm Rehabil Prev 2010; 30: 126–136.

110. Katz PP and Yelin EH. Life activities of persons with rheumatoid arthritis with and without depressive symptoms. Arthritis Care Res 1994; 7: 69–77.

111. Donaire-Gonzalez D, Gimeno-Santos E, Serra I, et al. Validation of the Yale Physical Activity Survey in chronic obstructive pulmonary disease patients. Arch Bronconeumol 2011; 47: 552–560.

112. Van Gestel AJR, Clarenbach CF, Stowhas AC, et al. Predicting daily physical activity in patients with chronic obstructive pulmonary disease. PLoS ONE 2012; 7: e48081.

113. Hoeymans ER, Wouters CM, Feskens EJM, et al. Reproducibility of performance-based and self-reported measures of functional status. J Gerontol Med Sci 1997; 52A: M363–M368.

114. Eakin EG, Sassi-Dambron DE, Ries AL, et al. Reliability and validity of dyspnea measures with obstructive lung disease. Int J Behav Med 1995; 2: 118–134.

115. Mahler D, Ward J, Waterman LA, et al. Patient-reported dyspnea in COPD reliability and association with stage of disease. Chest 2009; 136: 1473–1479.

116. Normandin EA, McCusker C, Connors ML, et al. An evaluation of two exercises to exercise conditioning in pulmonary rehabilitation. Chest 2002; 121: 1085–1091.

117. Witek TJ and Mahler DA. Minimal important difference of the transition dyspnea index in a multinational clinical trial. Eur Respir J 2003; 21: 267–272.

118. Chhabra SK, Gupta AK, and Khuma M. Evaluation of three scales of dyspnea in chronic obstructive pulmonary disease. Ann Thoracic Med 2009; 4: 128–132.

119. Wegner RE, Jorres RA, Kirsten DK, et al. Factor analysis of exercise capacity, dyspnea ratings and lung function in patients with severe COPD. Eur Respir J 1994; 7: 725–729.

120. Reilly CC, Bausewein C, Garrod R, et al. Breathlessness during daily activity: the psychometric properties of the London Chest Activity of Daily Living Scale in patients with advanced disease and refractory breathlessness. Palliat Med 2017; 31: 868–875.

121. Barriga S, Rodrigues F, and Barbara C. Factors that influence physical activity in daily life of male patients with chronic obstructive pulmonary disease. Rev Port Pneumol 2014; 20: 131–137.

122. Garrod R, Paul EA, and Wedzicha JA. An evaluation of the reliability and sensitivity of the London Chest Activity of Daily Living Scale (LCADL). Respir Med 2002; 96: 725–730.

123. Bisca GW, Proenca M, Salomao A, et al. Minimal detectable change of the London Chest Activity of Daily Living Scale in patients with COPD. J Cardiopulm Rehabil Prev 2014; 34: 213–216.

124. Fletcher CM, Elmes PC, Fairbairn AS, et al. The significance of respiratory symptoms and the diagnosis of chronic bronchitis in working populations. Br Med J 1959; 2: 257–266.

125. Hayata A, Minakata Y, Matsunga K, et al. Differences in physical activity according to mMRC grade in patients with COPD. Int J COPD 2016; 11: 2203–2208.

126. de Torres JP, Pinto-Plata V, Ingenito E, et al. Power of outcome measurements to detect clinically significant changes in pulmonary rehabilitation of patients with COPD. Chest 2002; 121: 1092–1098.

127. Wedzicha JA, Bestall JA, Garrod R, et al. Randomized controlled trial of pulmonary rehabilitation in severe chronic obstructive pulmonary disease patients, stratified by the MRC dyspnea scale. Eur Respir J 1998; 12: 363–369.

128. Oga T, Tsukino M, Hajiro T, et al. Analysis of longitudinal changes in dyspnea of patients with chronic obstructive pulmonary disease: an observational study. Respir Res 2012; 13: 85.

129. Woodstock A, Gross E, and Geddes D. Drug treatment of breathlessness: contrasting effects of diazepam and promethazine in pink puffers. Br Med J 1981; 283: 343–346.

130. Janssens JP, Breitenstein E, Rochat T, et al. Does the “Oxygen cost diagram” reflect changes in six minute
walking distance in follow up studies? Respir Med 1999; 93: 810–815.

131. Ries AL, Make BJ, Lee SM, et al. The effects of pulmonary rehabilitation in the national emphysema treatment trial. Chest 2005; 128: 3799–3809.

132. Ries AL. Minimally clinically important difference for the UCSD shortness of breath questionnaire, Borg scale, and visual analog scale. J COPD 2005; 2: 105–110.

133. Zhou Z, Zhou A, Zhao Y, et al. Evaluating the clinical COPD questionnaire: a systematic review. Respiratory 2017; 22: 251–262.

134. Kon SS, Dilaver D, Mittal M, et al. The clinical COPD questionnaire: response to pulmonary rehabilitation and minimal clinically important difference. Thorax 2014; 69: 793–798.

135. Wijkstra PJ, TenVergert EM, Van Altena R, et al. Reliability and validity of the clinical COPD questionnaire. Respir Med 2010; 104: 1675–1682.

136. Schu¨nemann HJ, Goldstein R, Mador MJ, et al. A randomised trial to evaluate the self-administered standardised chronic respiratory questionnaire. Eur Respir J 2005; 25: 31–40.

137. Moreira GL, Pitta F, Ramos D, et al. Portuguese-language version of the chronic respiratory questionnaire: a validity and reproducibility study. J Bras Pneumol 2009; 35: 737–744.

138. Wijkstra PJ, TenVergert EM, Van Altena R, et al. Reliability and validity of the chronic respiratory questionnaire (CRQ). Thorax 1994; 49: 465–467.

139. Williams JEA, Singh SJ, Sewell L, et al. Health status measurement: sensitivity of the self-reported chronic respiratory questionnaire (CRQ-SR) in pulmonary rehabilitation. Thorax 2003; 58: 515–518.

140. Lacasse Y, Goldstein R, Lasserson TJ, et al. Pulmonary rehabilitation for chronic obstructive pulmonary disease. Cochrane Database Syst Rev 2006; 18(4): CD003793.

141. Bhandri NJ, Jain T, Marolda C, et al. Comprehensive pulmonary rehabilitation results in clinically meaningful improvements in anxiety and depression in patients with chronic obstructive pulmonary disease. J Cardiopulm Rehabil 2013; 33: 123–127.

142. Kon SS, Dilaver D, Mittal M, et al. The clinical COPD questionnaire: response to pulmonary rehabilitation and minimal clinically important difference. Thorax 2014; 69: 793–798.

143. Kocks JWH, Tsiligianni IA, and van der Molen T. Responsiveness of the COPD assessment test. Chest 2012; 142: 267–268.

144. Alma H, de Jong C, Jelusic D, et al. Health status instruments for patients with COPD in pulmonary rehabilitation: defining a minimal clinically important difference. NPJ Prim Care Respir Med 2016; 26: 16041.

145. Barr JT, Schumacher GE, Freeman S, et al. American translation, modification, and validation of the St. George’s Respiratory Questionnaire. Clin Ther 2000; 22: 1121–1145.

146. Farne HA and Cates CJ. Long-acting beta2-agonist in addition to tiotropium versus either tiotropium or long-acting beta2-agonist alone for chronic obstructive pulmonary disease. Cochrane Database Syst Rev 2016; 5: CD005305.

147. Swigris JJ, Brown KK, Behr J, et al. The SF-36 and SGRQ: validity and first look at minimum important differences in IPF. Respir Med 2010; 104: 296–304.

148. Ware JE. SF-36 health survey update. Spine 2000; 25: 3130–3139.

149. Stewart AL and Ware JE. Measuring functioning and well-being: the medical outcomes study approach. Durham: Duke University Press, 1992.
157. Calik-Kutukcu E, Arikan H, Saglam M, et al. A comparison of activities of daily living in geriatric and non-geriatric patients with chronic obstructive pulmonary disease. *Turk J Geria* 2015; 18: 68–74.

158. Gulart AA, Munari AB, de Queiroz APA, et al. Does the COPD assessment test reflect functional status in patients with COPD. *Chron Respir Dis* 2017; 14: 37–44.

159. Karloh M, Karsten M, Pissaia FV, et al. Physiological responses to the Glittre-ADL test in patients with chronic obstructive pulmonary disease. *J Rehabil Med* 2014; 46: 88–94.

160. Paes T, Belo LF, da Silva DR, et al. Londrina Activities of Daily Living Protocol: reproducibility, validity, and reference values in physically independent adults age 50 years and older. *Respir Care* 2017; 62: 298–306. DOI: 10.4187/respcare.05059.

161. Ng BHP, Tsang HWH, Jones AYM, et al. Functional and psychosocial effects of health Qigong in patients with COPD: a randomized controlled trial. *J Altern Complement Med* 2011; 17: 243–251.

162. Collin C, Wade DT, Davies S, et al. The Barthel ADL Index: a reliability study. *Int Disabil Stud* 1988; 10: 61–63.

163. Braido F, Baiardini I, Menoni S, et al. Disability in COPD and its relationship to clinical and patient-reported outcomes. *Curr Med Res Opinion* 2011; 27: 981–986.

164. Shiao CC, Hsu HC, Chen IL, et al. Lower Barthel Index is associated with higher risk of hospitalization-requiring pneumonia in long-term care facilities. *Tohoku J Exp Med* 2015; 236: 281–288.

165. Hsieh YW, Wang CH, Wu SC, et al. Establishing the minimal clinically important difference of the Barthel Index in stroke patients. *Neurorehabil Neural Repair* 2007; 21: 233–238.

166. Altenburg WA, Bossenbroek L, de Gref MHG, et al. Functional and psychological variables both affect daily physical activity in COPD: a structural equations model. *Respir Med* 2013; 107: 1740–1747.

167. Suurmeijer TPBM, Doelgas DM, Moun T, et al. The Groningen Activity Restriction Scale for measuring disability: its utility in international comparisons. *Am J Public Health* 1994; 84: 1270–1273.

168. Duiverman ML, Wempe JB, Bladder G, et al. Health-related quality of life in COPD patients with chronic respiratory failure. *Eur Respir J* 2008; 32: 379–386.

169. Yohannes AM, Greenwood YA, and Connolly MJ. Reliability of the Manchester respiratory activities of daily living questionnaire as a postal questionnaire. *Age Ageing* 2002; 31: 355–358.

170. Yohannes AM and Roomi J. Elderly people at home disabled by chronic obstructive pulmonary disease. *Age Ageing* 1998; 27: 523–525.

171. Wu CY, Chuang LL, Lin KC, et al. Responsiveness, minimal detectable change, and minimal clinically important difference of the Nottingham Extended Activities of Daily Living Scale in patients with improved performance after stroke rehabilitation. *Arch Phys Med Rehabil* 2011; 92: 1281–1287.

172. Brooks SM. Surveillance for respiratory hazards. *American Thoracic Society News* 1982; 8: 12–16.

173. Canadian Council on Learning. *State of learning in Canada: no time for complacency*. Report on Learning in Canada, Ottawa, 2007.

174. Kale MS, Federman AD, Krauskopf K, et al. The association of health literacy with illness and medication beliefs among patients with chronic obstructive pulmonary disease. *PLoS One* 2015; 10: e0123937. DOI: 10.1371/journal.pone.0123937.

175. Berkman N, Sheridan K, Halpern D, et al. Low health literacy and health outcomes: an updated systematic review. *Ann Int Med* 2003; 163: 585–591.

176. Omachi T, Sarkar U, Yelin E, et al. Lower health literacy is associated with poorer health status and outcomes in chronic obstructive pulmonary disease. *J Gen Intern Med* 2013; 28: 74–81.

177. Li J and Fei G. The unique alterations of hippocampus and cognitive impairment in chronic obstructive pulmonary disease. *Respir Res* 2013; 14: 140.

178. Lahousse L, Vernooij M, Darweesh S, et al. Chronic obstructive pulmonary disease and cerebral microbleeds. The Rotterdam study. *Am J Respir Crit Care Med* 2013; 188: 783–788.

179. Dodd J, Chung A, van den Broek M, et al. Brain structure and function in chronic obstructive pulmonary disease: a multimodal cranial magnetic resonance imaging study. *Am J Respir Crit Care Med* 2012; 186: 240–245.