



Agreement of the modified Medical Research Council and New York Heart Association scales for assessing the impact of self-rated breathlessness in cardiopulmonary disease

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Shareable abstract (@ERSpublications)

There is moderate agreement between the mMRC and NYHA scales for assessment of functional impact of breathlessness in outpatients with COPD and heart failure. <https://bit.ly/2XBPuXF>

Cite this article as: Ahmadi Z, Igelström H, Sandberg J, *et al.* Agreement of the modified Medical Research Council and New York Heart Association scales for assessing the impact of self-rated breathlessness in cardiopulmonary disease. *ERJ Open Res* 2022; 8: 00460-2021 [DOI: 10.1183/23120541.00460-2021].

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This article has supplementary material available from openres.ersjournals.com

Received: 9 July 2021
Accepted: 12 Sept 2021

Abstract

Background The functional impact of breathlessness is assessed using the modified Medical Research Council (mMRC) scale for chronic respiratory disease and with the New York Heart Association Functional Classification (NYHA) scale for heart failure. We evaluated agreement between the scales and their concurrent validity with other clinically relevant patient-reported outcomes in cardiorespiratory disease.

Methods Outpatients with stable chronic respiratory disease or heart failure were recruited. Agreement between the mMRC and NYHA scales was analysed using Cramér's V and Kendall's tau B tests. Concurrent validity was evaluated using correlations with clinically relevant measures of breathlessness, anxiety, depression, and health-related quality of life. Analyses were conducted for all participants and separately in chronic obstructive pulmonary disease (COPD) and heart failure.

Results In a total of 182 participants with cardiorespiratory disease, the agreement between the mMRC and NYHA scales was moderate (Cramér's V: 0.46; Kendall's tau B: 0.57) with similar results for COPD (Cramér's V: 0.46; Kendall's tau B: 0.66) and heart failure (Cramér's V: 0.46; Kendall's tau B: 0.67). In the total population, the scales correlated in similar ways to other patient-reported outcomes.

Conclusion In outpatients with cardiorespiratory disease, the mMRC and NYHA scales show moderate to strong correlations and similar associations with other patient-reported outcomes. This supports that the scales are comparable when assessing the impact of breathlessness on function and patient-reported outcomes.

Introduction

Breathlessness is a key characteristic of chronic cardiorespiratory disease, often limiting daily life [1, 2]. Breathlessness is reported to be a stronger predictor of mortality than airflow limitation in chronic obstructive pulmonary disease (COPD) [3] and is a negative prognostic factor for survival across severities of heart failure [4, 5].



Breathlessness comprises several dimensions that can be differentiated by the individual, including the experienced intensity and unpleasantness, the associated emotional response, and the functional impact on the individual's life [6]. In an everyday clinical context, the modified Medical Research Council (mMRC) scale is often used among COPD patients to rate the functional impact of their breathlessness [7] together with health status ratings from the COPD Assessment Test (CAT) [8]. The New York Heart Association Functional Classification (NYHA) scale is routinely used in heart failure to assess the functional impact of breathlessness on patients, to classify disease severity [9], for risk stratification as well as for clinical trial enrolment and candidacy for drugs and devices [10].

The mMRC and NYHA scales are quite alike in both content and structure, consisting of four categories with higher classes indicating more severe symptoms, limitation of physical activity and worse health [7, 9]. While the scales share many similarities, the mMRC scale reflects the patient's subjective experience, whereas an NYHA class is assigned by a clinician on the basis of an indirect interpretation of symptoms reported by the patient or, in some cases, self-completed questionnaires. Despite being used extensively both in clinical practice and research [11], the agreement between the scales has not been reported.

Information on how well the scales correlate might be useful for patients with both lung and heart disease or when research data from studies employing both scales are compared or pooled. As of today, research including patients with chronic respiratory disease and/or heart failure may have used both scales. If the scales were interchangeable, one of the scales could be prioritised, at least when it comes to assessments of the functional impact of breathlessness.

The primary aim of this study was to evaluate the correlation between self-reported mMRC and NYHA scales and their concurrent validity with other relevant patient-reported outcome measures (PROMs) in patients with chronic respiratory disease or chronic heart failure. The secondary aim was to explore differences in terms of measurement properties between the patient groups. Our hypothesis was that the scales would show high agreement and similar concurrent validity with other PROMs.

Material and methods

Study design and population

This was a prospective, multi-centre, cohort study of outpatients with breathlessness and physician-diagnosed chronic cardiorespiratory disease in Sweden. The database was previously used for validation of the Swedish versions of the Multidimensional Dyspnoea Profile (MDP) and Dyspnoea-12 (D-12) scales [12–14]. Written informed consent was obtained from all participants and the protocol was approved by the regional ethics committee at Lund University (DNr: 2016/16).

Participants were recruited from five outpatient clinics between 29 August 2016 and 23 December 2017. Inclusion criteria (all required) were: age 18 years or older; physician-diagnosed chronic respiratory disease and/or chronic heart failure; self-reported breathlessness during daily life defined as an answer "yes" to the question "did you experience any breathlessness during the last 2 weeks?"; and ability to provide written informed consent.

Exclusion criteria were: inability to write or understand Swedish adequately to participate; cognitive or other inability to participate in the study; and estimated survival less than 3 months.

Assessments

The mMRC and NYHA scales (table 1) were self-completed by the participants at the first clinical visit (baseline), together with a questionnaire on demographics, smoking status and pack-years of smoking, MDP scale, D-12 scale, 0–10 numeric rating scale (NRS), disease-specific health status using the CAT scale, generic health status using the EuroQol-five dimension-five level scale (EQ-5D-5L index), the Hospital Anxiety and Depression Scale (HADS), and the Functional Assessment of Chronic Illness Therapy–Fatigue (FACIT-F). The time period for all self-reported measures (except for current distressing breathlessness) was "during the previous 2 weeks".

Statistical analyses

Baseline patient characteristics were tabulated using standard descriptive statistics. Agreement between the mMRC and NYHA scales was evaluated using non-parametric correlation analyses Kendall's tau B and Cramér's V. Concurrent validity with other PROMs (MDP, D-12, CAT, EQ-5D-5L index, HADS, FACIT-F and 0–10 NRS) was analysed using Spearman's rank-order correlation test. The analyses were conducted for all participants, and separately in participants with COPD and heart failure as the primary

TABLE 1 The modified Medical Research Council (mMRC) scale and the New York Heart Association (NYHA) scale

Response category	mMRC	NYHA
0	Breathlessness only with strenuous exercise	
1	Breathlessness when hurrying on the level or up a slight hill	No limitation in ordinary physical activity
2	Breathlessness when walking at own pace on the level	Mild breathlessness and fatigue, slight limitation during ordinary activity
3	Breathlessness when walking 100 yards or for a few minutes	Marked limitation of physical activity due to breathlessness and fatigue even during less-than-ordinary activity
4	Breathless when taking a bath or breathless while dressing/undressing	Experience symptoms even while at rest

Clinical and physiological data were obtained from the participants' medical records on diagnosed disease; current medications; height and weight; left ventricular ejection fraction from echocardiography; spirometry post-bronchodilator values of forced expiratory volume in 1 s and, if not available, replaced by pre-bronchodilator values.

cause of breathlessness. Missing data were handled as missing at random and only complete cases were used in analyses.

Statistical significance was defined as a two-sided p -value < 0.05 . Statistical analyses were conducted using the software packages Stata, version 13 (StataCorp LP; College Station, TX), and Matlab R2018b (Mathworks, Inc., Natick, MA).

Results

A total of 182 participants were included: mean age 68.6 (standard deviation (SD) 13.8) years; 53% women; main reasons for breathlessness were COPD (25%), asthma (21%), idiopathic pulmonary fibrosis (19%) and heart failure (19%), as shown in table 2.

Agreement between the mMRC and NYHA scales

In the total population, mMRC ≥ 2 was reported by $n=127$ (70%) and, among these, all of them reported NYHA ≥ 2 . Similarly, NYHA ≥ 2 was reported by $n=180$ (99%) of the total population and among them 71% also reported mMRC ≥ 2 (figure 1).

The agreement between the mMRC and NYHA scales was moderate in the total sample (Cramér's V: 0.46; Kendall's tau B: 0.57; $n=181$). For the subgroups, similar moderate agreement was found both in participants with COPD (Cramér's V: 0.46; Kendall's tau B: 0.66; $n=44$) and heart failure (Cramér's V: 0.46; Kendall's tau B: 0.67; $n=35$).

Concurrent validity

Concurrent validity of the instruments is compared in figure 2. The mMRC and NYHA scales associated with other PROMs very similarly, including for measures of breathlessness (MDP, D-12), health-related quality of life (CAT, EQ-5D-5L index), anxiety and depressive symptoms (HADS scores), and fatigue (FACIT-F). All estimates are shown in supplementary table E1.

In the two diagnosis subgroups, however, the two scales showed different patterns. Among patients with COPD, both scales showed moderate concurrent validity to all PROMs measuring breathlessness. However, the NYHA scale was not associated to the affective dimension of breathlessness (D-12 affective). In this group, the strongest concurrent validity was found between the NYHA scale and the EQ-5D-5L index ($r=-0.73$). In patients with heart failure, the mMRC scale showed stronger correlations than the NYHA scale for several aspects of breathlessness (MDP and D-12 total and physical domain score) and fatigue (FACIT-F). In COPD, the NYHA scale had stronger associations to anxiety and depressive symptoms (HADS total, anxiety, depression), while the mMRC scale had no correlation to depressive symptoms (HADS depression). In heart failure, both scales had similar concurrent validity to anxiety and depressive symptoms (HADS total, anxiety). However, the NYHA scale was not associated to depressive symptoms (HADS depression).

TABLE 2 Baseline characteristics in 182 patients with cardiorespiratory disease

Characteristic	All n=182	COPD n=45	Heart failure n=35
Age, years	68.6±13.8	71.7±9.3	76.8±7.9
Females	97 (53.3)	27 (60)	9 (25.7)
Main cause of breathlessness			
Chronic obstructive pulmonary disease	45 (24.7)		
Asthma	39 (21.4)		
Heart failure	35 (19.2)		
Idiopathic pulmonary fibrosis	34 (18.7)		
Other interstitial lung disease	10 (5.5)		
Other	16 (8.8)		
	n=179		
Spirometry			
FEV ₁ , L	1.9±0.8 n=152	1.4±0.7 n=44	2.2±0.8 n=12
FEV ₁ , % predicted	75.2±25.8 n=151	57.6±21.2 n=44	88.7±27.7 n=12
VC, L	2.7±1.0 n=112	2.9±1.1 n=44	2.9±1.1 n=13
VC, % predicted	78.7±20.7 n=152	80±21.6 n=44	78.2±23.6 n=13
FEV ₁ /VC	0.7±0.2 n=152	0.5±0.1 n=44	0.7±0.1 n=12
Left ventricular ejection fraction	45.7±14.8 n=73	52.1±9.7 n=13	37 ±13 n=34
Smoking status			
Current smoker	19 (10.4)	9 (20)	2 (5.8)
Former smoker	107 (58.8)	33 (73.3)	23 (65.7)
Never smoker	54 (29.7)	3 (6.7)	9 (25.7)
	n=180	n=45	n=34
Body mass index, kg·m ⁻²	27.4±6.2 n=181	26.9±7.9 n=45	30.2±5.7 n=35
mMRC			
0	7 (3.8)	3 (6.7)	0
1	48 (26.4)	8 (17.8)	7 (20)
2	37 (20.3)	10 (22.2)	4 (11.4)
3	33 (18.1)	9 (20)	9 (25.7)
4	57 (31.3)	15 (33.3)	15 (42.9)
	n=182	n=45	n=35
NYHA			
1	1 (0.5)	0	0
2	54 (29.7)	15 (33.3)	8 (22.9)
3	90 (49.5)	22 (48.9)	15 (42.9)
4	36 (19.8)	7 (15.6)	12 (34.3)
	n=181	n=44	n=35
MDP total score	40.3±26.5 n=159	41.1±28.5 n=39	42.4±27.6 n=32
MDP immediate perception	24.3±14.9 n=163	25.1±15.5 n=39	25.9±16.2 n=33
MDP emotional response	16.0±13.5 n=176	16 ±13.5 n=45	16.2±13.8 n=34
MDP A1 unpleasantness score	4.94±2.53 n=176	5±2.4 n=43	5.5±2.6 n=35
D-12 total score	15.8±9.1 n=167	17.1±8.9 n=39	16.0±8.9 n=31
D-12 physical	9.8±5.3 n=174	10.5±5 n=42	9.9±5.4 n=33
D-12 affective	6.1±4.4 n=174	6.5±4.6 n=41	5.8±4.1 n=33
CAT	20.0±7.8 n=177	19.6±8.6 n=45	19.2±7.3 n=33

Continued

TABLE 2 Continued

Characteristic	All n=182	COPD n=45	Heart failure n=35
EQ-5D-5L index (UK)	0.61±0.27 n=181	0.61±0.27 n=45	0.58±0.31 n=35
HADS total score	9.94±6.83 n=177	9.64±6.61 n=44	10.76±8.93 n=34
HADS anxiety	5.66±4.21 n=179	5.64±4.17 n=45	5.53±4.93 n=34
HADS depression	4.27±3.26 n=179	4.00±3.03 n=44	5.24±4.27 n=1
FACIT-F	30.4±12.2 n=172	31.45±13.41 n=42	27.0±12.1 n=32

Data are presented as mean±SD deviation or frequency (percentage) for all participants (n=182) and for participants with COPD (n=45) and heart failure (n=35), respectively, as the primary cause of breathlessness. CAT: COPD Assessment Test; D-12: Dyspnoea-12; EQ-5D-5L: EuroQol Five-Dimension Five-Level scale; FACIT-F: Functional Assessment of Chronic Illness Therapy–Fatigue; FEV₁: forced expired volume in 1 s; HADS: Hospital Anxiety and Depression Scale; MDP: Multidimensional Dyspnoea Profile; mMRC: modified Medical Research Council breathlessness scale; NYHA: New York Heart Association scale; VC: vital capacity (the highest value of the slow and forced VC).

Discussion

The main findings were that, in outpatients with cardiorespiratory diseases, the mMRC and NYHA scales showed moderate agreement regarding the functional impact of breathlessness, both overall and among patients with COPD and heart failure, respectively. Since the scales are used for characterisation and discrimination of disease severity, the mMRC and NYHA scales associated in a similar way to other clinically relevant patient-reported outcomes.

The findings of moderate agreement but similar concurrent validity can be interpreted as that although the scores on the mMRC and NYHA scales are not directly interchangeable, higher scores on the scales associate similarly to markers of disease severity and relevant patient-reported outcomes.

What this study adds

This is the first study to evaluate the agreement between self-reported mMRC and NYHA scales and their concurrent validity with clinically relevant PROMs in outpatients with cardiorespiratory diseases. The present findings extend our knowledge that both scales exhibit similar concurrent validity with other relevant PROMs measuring breathlessness (assessed using D-12), health status (EQ-5D-5L index and CAT), anxiety and depressive symptoms (HADS), and fatigue (FACIT-F) and we think that these results suggest that the scales may be comparable and useful across the cardiorespiratory conditions. Findings were generally similar between the subgroups of COPD and heart failure patients. Some minor differences in correlations seen between the subgroups should be interpreted with caution owing to lower precision due to

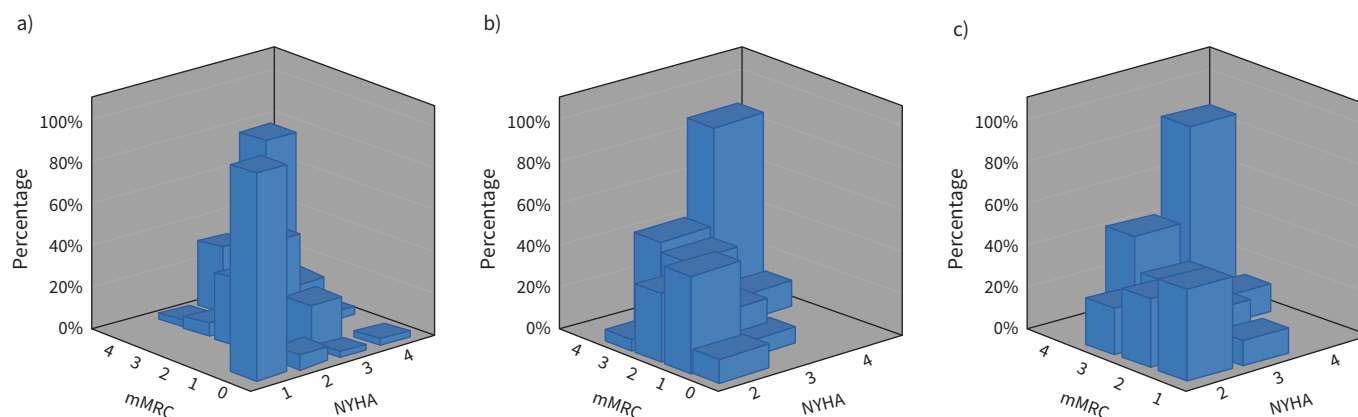


FIGURE 1 Percentage of patients in each response category in the modified Medical Research Council breathlessness (mMRC) scale and the New York Heart Association (NYHA) scale. **a)** All patients. **b)** Patients with chronic obstructive pulmonary disease. **c)** Patients with heart failure.

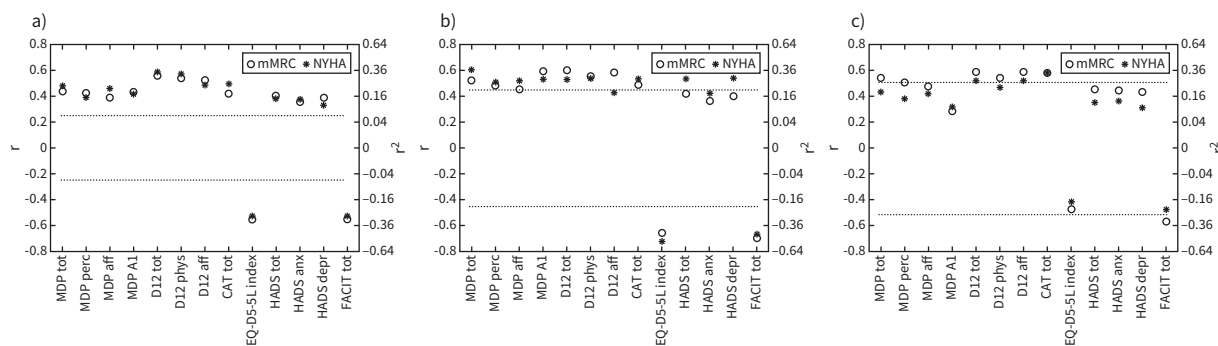


FIGURE 2 Concurrent validity between the modified Medical Research Council (mMRC) scale and the New York Heart Association (NYHA) scale, respectively, and the Multidimensional Dyspnoea Profile (MDP), Dyspnoea-12 (D-12), COPD Assessment Test (CAT), EuroQol-five dimension-five level scale (EQ-5D-5L), Hospital Anxiety and Depression Scale (HADS) and the Functional Assessment of Chronic Illness Therapy–Fatigue (FACIT-F). **a)** All participants. **b)** Chronic obstructive pulmonary disease subgroup. **c)** Heart failure subgroup. The dashed line indicates the significance level of r ($p=0.002$). aff: affective; anx: anxiety; depr: depression; perc: percentage; phys: physical; tot: total.

fewer participants in the subgroups. In general, the mMRC and NYHA scales seem to capture similar findings that are consistent with other PROMs in the total population as well as in COPD and heart failure.

Strengths and limitations

The strengths of the present study are that it included a large sample of outpatients in clinical practice. We included participants across a range of chronic respiratory diseases such as COPD, asthma and idiopathic pulmonary fibrosis and included a comparison group of patients with chronic heart failure. In the present study, we analysed the total sample and the subgroups separately, because in clinical practice there is usually a significant overlap of respiratory and heart disease in patients and to maximise the power of the study.

Limitations include that the number of participants in each of the groups was relatively small to allow specific analyses for those diagnoses. Although the study was multicentre, the findings should be interpreted within the context of only including individuals with knowledge of the Swedish language and, thus, require validation in other target populations and settings in order to be generalizable. In the present study, self-reported mMRC and NYHA scales were employed, in contrast with the clinician-assigned NYHA scale, which is more common in clinical practice. However, we believe that our analysis with self-reported questionnaires make the scales more comparable and the data more robust. The study was conducted in the setting of outpatient clinics, which might affect the standardisation of the conditions, including the information and instructions given in relation to the assessments. At the clinical visit, the research staff were instructed to inform the participants that the questions mostly pertained to experiences during the past 2 weeks.

Implications

The findings support that the scales measure the same underlying construct of the functional impact of breathlessness and are comparable for use in clinical practice and research when assessing the functional impact of breathlessness and in terms of patient-reported outcomes. More knowledge could be generated by recruiting larger patient samples with chronic heart failure and concurrent COPD. A few studies have been conducted and they report a prevalence of 10–35% of co-existing COPD and heart failure depending on the criteria used for diagnosis of disease [15, 16]. In those with overlap of COPD and heart failure, either the mMRC scale or the NYHA scale could be used in clinical practice to assess the functional impact of breathlessness given that the scales seem to be comparable.

Interestingly, in the total sample, both scales were associated with anxiety and depression (HADS), but some differences were found, with the mMRC scale showing concurrent validity to depressive symptoms (HADS depression) in heart failure and the NYHA scale having better concurrent validity regarding anxiety and depression in persons with COPD. We hypothesise that this finding reflects that depression and anxiety increase along with the deterioration of physical status in people with chronic cardiorespiratory disease. Although our subgroup findings might be due to chance, given the small subgroup sizes, the stronger concurrent validity of the mMRC scale with other breathlessness scales (MDP and D-12) in chronic heart failure is of special interest and should be further validated.

Conclusion

The results of this study suggest that there is moderate agreement between the mMRC and NYHA scales for assessments of the functional impact of breathlessness in outpatients with COPD and heart failure.

Provenance: Submitted article, peer reviewed.

Acknowledgements: The authors thank all research nurses who dedicated their time and work to make this study possible: nurses at the respiratory outpatient clinic in Karlskrona; Lisa Carlson, Karolinska University Hospital Solna, Stockholm; Annika Johansson and Frida Holmström, University Hospital, Umeå; Karin Johansson, Örebro University Hospital; and Jonatan Blomqvist, Lund, for help with data input and quality checking. The authors extend their warm thanks to all patients who made this research possible.

Conflict of interest: No conflicts of interest exist for the authors.

Support statement: The study was funded by unrestricted grants from the Swedish Respiratory Society, the Swedish Heart-Lung Foundation, the Swedish Society for Medical Research and the Swedish Research Council (Dnr: 2019-02081). Funding information for this article has been deposited with the Crossref Funder Registry.

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