

ONLINE SUPPLEMENTARY MATERIAL

Statistical tests used in Rasch analysis

The test for item-trait interaction shows the overall fit of the instrument to the unidimensional model. Chi-squared tests were used to assess the degree to which the data diverged from the model, with a Bonferroni correction ($p=0.005$). For individual item fit, a threshold map in the location order was used to identify the items that did not demonstrate monotonically increased responses. Individual item test-of-fit shows the chi-squared probability (5% significant level) for each item, where the value of $p<0.05$ was marked as a mis-fitting item). The residual scores show the difference between item-person interaction and the degree of divergence of the person within an item in a model. A negative residual figure shows item over-fitting; the information provided by that item does not add any additional value to the overall measure. A high positive residual number shows item under-fitting, indicating that the item has a poor fit to the model and the response categories are under-discriminating (or not discriminating) differences in severity.

Table 1. Summary of Item Deletion

Item	Reason for Deletion
I can leave my home whenever I want--I never leave my home because of my lung condition	<ul style="list-style-type: none">• Floor effect of 44%
I enjoy being around other people despite my lung condition—I don't feel like being around other people because of my lung condition	<ul style="list-style-type: none">• Floor effect of 47%
My sleep is not interrupted by my lung condition during the night—My sleep is very interrupted because of my lung condition	<ul style="list-style-type: none">• Floor effect of 27%
I never use a rescue inhaler—I use a rescue inhaler a lot during the night and day	<ul style="list-style-type: none">• Low item-to-total correlation ($r=0.52$)
When I walk on a flat surface at my usual pace my breathing is easy—When I walk on a flat surface at my usual pace my	<ul style="list-style-type: none">• High item-to-item correlation with “When I walk on a flat surface at my usual pace I am (not/very) breathless”

breathing is difficult	<p>($r=0.86$)</p> <ul style="list-style-type: none"> • Potential translatability problem with concept of breathing “easy/difficult”
When I walk up a hill or one flight of stairs my breathing is easy—When I walk up a hill or one flight of stairs my breathing is difficult	<ul style="list-style-type: none"> • High item-to-item correlation with “When I walk up a hill or one flight of stairs I am (not/very) breathless” ($r=0.89$) • Potential translatability problem with concept of breathing “easy/difficult”
I can do any activity I need to at home—I can’t do any activity I need to at home	<ul style="list-style-type: none"> • High item-to-item correlation with “I am (not/very) limited doing any activity at home” ($r=0.84$) • Similar item has wider distribution of responses and better worded
I feel in control of my lung condition—I feel like my lung condition controls me	<ul style="list-style-type: none"> • Performed poorly in Item Response Theory (IRT) analysis with least overall fit, suggesting that patients underestimate “lung control” relative to disease severity. • Clear psychological factors operating
When I walk on a flat surface at my usual pace I am not breathless—When I walk on a flat surface at my usual pace I am very breathless	<ul style="list-style-type: none"> • IRT analysis indicates scaling redundancy with “limited activity at home” • Content similarity with “When I walk up a hill or one flight of stairs I am (not/very) breathless • Instead use “walk up hill breathless” (targets mild patients) and “limited activity at home” (targets more severe patients) to increase content and scaling
I am not tired at all—I am very tired	<ul style="list-style-type: none"> • IRT analysis indicates poor item fit

	<ul style="list-style-type: none"> • Similar in content to “energy” item
I never wheeze—I wheeze all the time	<ul style="list-style-type: none"> • IRT analysis indicates less good fit consistently • Potential translation problem of “wheeze”
I always wake up refreshed—I never wake up refreshed	<ul style="list-style-type: none"> • IRT analysis indicates significant country effect
I am not anxious at all—I am very anxious because of my lung condition	<ul style="list-style-type: none"> • IRT analysis indicates definite country effect, • IRT analysis indicates small but significant gender effect

Table of mean item severity

Figure 1 in the paper shows the level of severity for each category of response for each item. The mean severity of each item is tabulated below to show the hierarchy of severity across the items. The items are presented in descending order of severity (–ve logit indicates less severe)

CAT item no.	Item	Severity (logits)
6	Confidence	0.86
3	Tight	0.48
5	Activities	0.23
7	Sleep	0.23
2	Phlegm	-0.09
8	Energy	-0.15
1	Cough	-0.45
4	Breathless	-1.10