emPHasis-10
ONLINE SUPPLEMENTARY MATERIAL

emPHasis-10 was developed using hierarchical methods of item reduction [Table 1] and Rasch analysis [Table 2]. Rasch analysis involves an iterative process whereby the least fitting item is removed and the effect on the fit of the remaining is then retested. This process is continued until each item demonstrates a good fit to the model and the stability of the overall item-set also meets model requirements for it to be a reliable uni-dimensional measure [1,2]. This enabled an examination of the contribution of items individually and facilitated the selection of items that provide maximum measurement precision.

Individual item fit was assessed by examining the residual and Chi squared fit statistic for each item (item residual ±2.5 and chi-square p value > 0.05) [2]. The item residual is a summation of the difference between the observed score and the score expected by the model for a particular item and persons . Item residuals between ±2.5 indicate adequate fit to the model [2]. The Chi-square (x^2) compares the difference between the observed values with values expected by the model across different levels of health for each item. These groups are defined by ordering all patients responses and then splitting them into groups of approximately equivalent size across the sample. A non-significant item Chi-square (p >0.05) indicates good fit to the model. Items with the worst model fit were removed whilst ensuring that the balance of retained items and content validity for the total item-set was retained. The overall fit of the final item-set was determined by examining the person item-trait interaction chi-square statistic where a non significant (p >0.05) indicates fit to the model) [2].

Table 1 illustrates reasons for item removal, including both hierarchical and Rasch analysis and Table 2 provides the fit statistics for the final 10 items that make up the emPHasis-10.

Table 1: Summary of reasons for item deletion

Item	Reason for deletion
I feel attractive – I feel very unattractive	Gender bias (p = 0.006)
I do not feel anxious – I feel very anxious	Gender bias (p = 0.01)
I feel breathless when kneeling or bending – I do not feel breathless when kneeling or bending	Age bias (p = 0.01)
I find activities where I need to raise my arms difficult – I do not find activities where I need to raise my arms difficult	Age bias (p = 0.02)
I am able to live a full life – I am not able to live a full life	Age bias (p = 0.02)
I am able to lie flat – I am not able to lie flat	Floor effect 33%
I do not find talking tiring – I find talking tiring	Floor effect 26%
I do not find eating tiring – I do find eating tiring	Floor effect 42%
I have enough energy to stay out all day – I do not have enough energy to stay out all day	Ceiling effect 28%
I am able to live carefree – I am not able to live carefree	Ceiling effect 26%
I am able to stand for long periods – I am not able to stand for long periods of time	Ceiling effect 26%
I do not need to plan ahead – I always need to plan ahead	Ceiling effect 30%
I never feel dizzy or lightheaded – I always feel dizzy of lightheaded	Low item-total correlation
I do not worry about the impact my PH has on my family – I always worry about the impact that my PH has on my family	Item-item correlations
I am able to fulfil my family duties – I am not able to fulfil my family duties	Item-item correlations
I do not worry about my PH – worry about my PH	Item-item correlations
Breathlessness does not disrupts my life – breathlessness does disrupts my life	Item-item correlations
I never feel out of breath – I always feel out of breath	Rasch analysis – significant item chi-square
I become out of breath with little activity – I do not become out of breath with little activity	Rasch analysis – High item residual
Having PH does not restrict my social life – Having PH restricts my social life	Rasch analysis – significant item chi-square
I have hope – I do not have any hope	Rasch analysis – significant item chi-square and high item residual
I do not feel like a burden to other people – I always feel like a burden to other people	Rasch analysis – significant item chi-square, and low logit location

Table 2: Individual fit of the retained 10 items to the Rasch unidimensional model

Item	Item Fit (±2.5)	X^2 p value (< 0.05)	Logit: Item severity (location)
Q4. Breathlessness interrupts conversations	1.8	0.4	0.85
Q20. Confident in pubic/crowds	0.65	0.7	0.65
Q25. Independent	-0.29	0.5	0.30
Q30. Burden to family/friends	0.5	0.3	0.21
Q24. PH controls my life	-1.1	0.5	0.05
Q3. Breathlessness frustrating	1.2	0.3	-0.03
Q11. Exhausted	0.2	0.1	-0.07
Q8. Need to rest during the day	0.8	0.6	-0.17
Q13. Have lots of energy	1.2	0.7	-0.28
Q17. Stairs or slight hill makes me breathless	1.0	0.6	-1.51

The last column (Logit) shows the mean level of severity for each item. Items are presented in descending order of severity (-ve logit indicates less severe and +ve indicates more severe). This is also depicted graphically in figure 1 in the paper.

References:

1. Yorke J, Horton M, Jones PW. A critique of Rasch analysis using the Dyspnoea-12 as an illustrative example. *JAN* 2011; 68(1):191-98.

2. Pallant JF, Tennant A. An introduction to the Rasch measurement model: an example using the Hospital Anxiety and Depression Scale (HADS). *British Journal of Clinical Psychology* 2007; 46: 1–18.