Should heart failure be considered as categorical or dimensional?

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INTRODUCTION

The categorical view dominates the traditional diagnostic approach to heart failure (HF) but ignores possible within-class heterogeneity such as individual differences in severity.

OBJECTIVE

To assess if HF should be considered categorical or dimensional, and to validate a novel scale of severity for clinical HF.

METHODS

Participants were selected within the first follow-up of a representative cohort of the non-institutionalized adult population of Porto, Portugal – the EPIPorto cohort study. Between October 2006 and July 2008, all participants aged 45 years or over were eligible to a systematic evaluation of parameters of cardiac structure and function, which included a cardiovascular clinical history and physical examination, and a bidimensional transthoracic echocardiogram. Among 2048 eligible for this study, 134 (6.5%) had died, 198 (9.7%) refused to be re-evaluated and 580 (28.3%) were lost to follow up, and 21 (1.0%) had missing values in key variables. Therefore, 1115 (54.6%) individuals were analyzed. The mean (standard deviation) age was 63 (11) years, 680 (61%) were women, the mean (standard deviation) level of education was 8 (5) years, 306 (27%) were obese and 655 (59%) had hypertension.

We considered 12 items related to troubled breathing/fatigue (4 items), volume overload (4 items), history of myocardial infarction and objective evidence of cardiac structural /functional abnormalities (4 items) frequently used in the diagnosis of HF (table 1). Latent class analysis (LCA) and factor analysis (FA) were use to identify categorical and dimensional representations of the items, respectively.

B-type natriuretic peptide (BNP) and American College of Cardiology (ACC)/American Heart Association (AHA) stages of HF, classified by experienced clinicians with access to all data, were used to validate the scale. BNP was measured in a subgroup of the study sample (n=630). Odds ratios (OR), estimated by logistic regression, and their respective 95% confidence intervals (95%CI) were used to measure the magnitude of associations between BNP and the ACC/AHA stages C-D of HF, and the latent classes and the factor analysis score. Bayesian information criteria (BIC) were used to assess if HF should be considered as categorical or dimensional, and which representation showed better fit with BNP values and the ACC/AHA stages. A model with a lower BIC is preferred over one with higher indices.

RESULTS

Bayesian information criteria suggested a 3-class solution for the LCA and the 1-factor solution for the FA, with the latter being the best result (figure 1). The first factor was strongly associated with the items on troubled breathing/fatigue and moderately associated with the items about volume overload and cardiac abnormalities (table 1).

Figure 1. Factor analysis and latent class analysis model fit

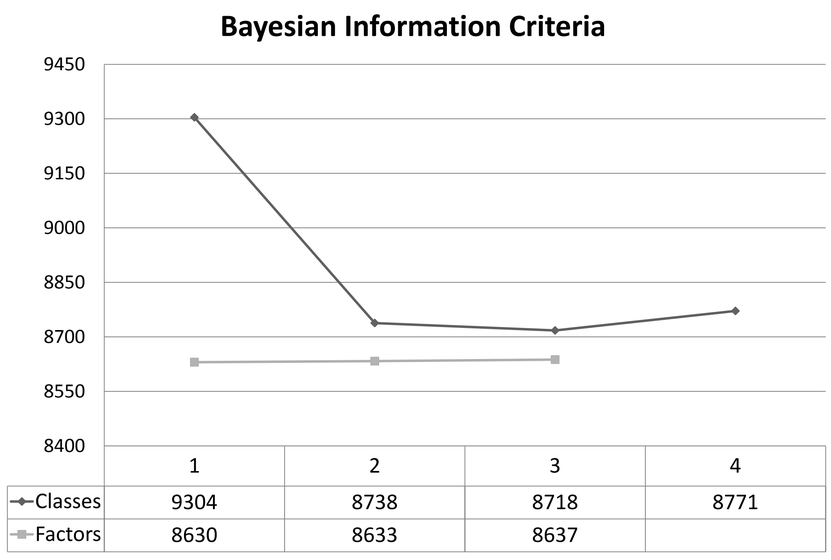

Table 1. Factor loadings for the 1- and 2-factor models

Items	Factor analysis		
	1-factor solution	2- factor solution	
	1	1	2
Dyspnoea	**0.879**	**0.739**	0.267
Fatigue	**0.700**	**0.658**	0.132
Orthopnoea	**0.829**	**0.889**	-0.003
Nocturnal paroxysmal dyspnoea	**0.704**	**0.793**	-0.073
Lower limb oedema at the end of the day (symptom)	0.497	**0.322**	**0.277**
Lower limb oedema (physical examination)	0.513	0.203	**0.444**
Pulmonary rales	0.438	0.027	**0.545**
Hepatojugular reflux or jugular venous distension	0.378	-0.003	**0.503**
Heart murmur	0.320	-0.021	**0.441**
History of myocardial infarction	0.513	0.109	**0.535**
Left ventricular systolic dysfunction	0.524	-0.096	**0.782**
Left ventricular diastolic dysfunction	0.378	0.143	**0.506**

In the 1-factor analysis, the first, second and third latent classes presented higher, intermediate and lower scores, respectively (figure 2).

The fit indices of the 1-factor score were better than the 3-latent class model regarding the association with BNP ≥100pg/mL and stage C-D of clinical HF. The prevalence BNP≥100pg/mL and stage C-D of clinical HF was significantly higher in individuals with higher scores than in individuals with lower scores (table 2).

Figure 2. Relation between the 3-latent class model and the 1-factor analysis score

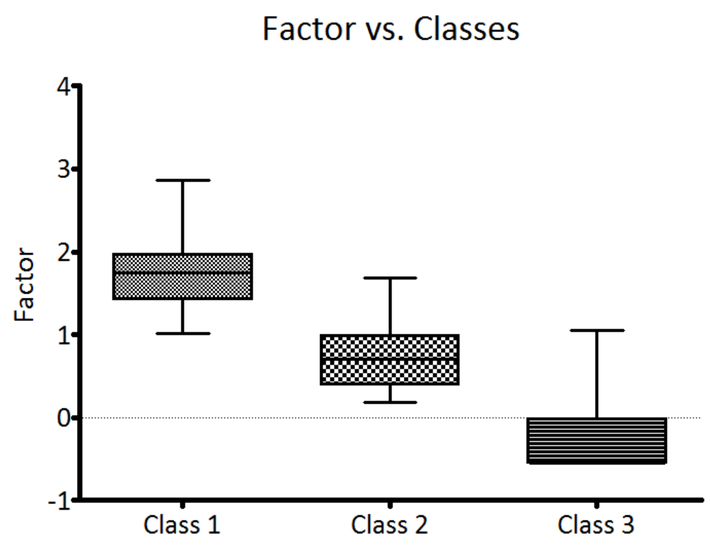

Table 2. Logistic regression of B-type natriuretic peptide ≥100pg/mL and stages C-D of ACC/AHA according to the 1-factor score and the 3 latent classes

	BNP≥100pg/mL			Stages C-D of ACC/AHA		
	OR	95%CI	BIC	OR	95%CI	BIC
Latent Classes Analysis						
Class 1	12.9	4.7, 35.5	275.2	135.1	39.5, 462.1	323.9
Class 2	8.2	3.4, 19.7		25.9	7.8, 86.5	
Class 3	Ref			Ref		
Factor Analysis						
1-Factor	3.6	2.4, 5.4	266.6	13.2	7.9, 21.9	275.3

CONCLUSION

The use of latent models applied to HF provided evidence for considering HF as dimensional rather than the traditional categorical view.