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ORIGINAL ARTICLE

Association of types of dyspnea including 'bendopnea' with cardiopulmonary disease in primary care☆

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Abstract
Introduction: Dyspnea is the symptom most commonly reported by patients with heart failure (HF) and/or pulmonary disease, the obese and the elderly. Recently 'bendopnea' (shortness of breath when bending forward) has been described in patients with HF.
Objective: To determine the association of exertional dyspnea, orthopnea, paroxysmal nocturnal dyspnea and bendopnea with chronic disease, especially heart failure, and their phenotypes in primary care.
Methods: This cross-sectional study included 633 individuals aged between 45 and 99 years enrolled in a primary care program in Niteroi, Brazil. Participants underwent clinical assessment and laboratory tests and completed a questionnaire, all on the same day.
Results: Paroxysmal nocturnal dyspnea and bendopnea were associated with HF (unadjusted OR 2.42, 95% CI 1.10-5.29 and OR 2.59, 95% CI 1.52-4.44, respectively). In multivariate models, chronic obstructive pulmonary disease, coronary heart disease and myocardial infarction were not associated with bendopnea.
Conclusion: Bendopnea was the only type of dyspnea not linked to respiratory disease or coronary heart disease. Even after adjusting for depression and body mass index, the association

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remained with HF with or without preserved ejection fraction, and bendopnea thus appears to be a promising symptom to differentiate HF from the other two disease groups.

PALAVRAS-CHAVE
Insuficiência cardíaca;
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Dispneia;
Dispneia paroxística noturna;
Flexopneia

Associação dos tipos de dispneia e da 'flexopneia' com as patologias cardiopulmonares nos cuidados de saúde primários

Resumo
Introdução: A dispneia é o sintoma mais comummente reportado por pacientes com insuficiência cardíaca, doenças pulmonares, obesos e idosos. Recentemente, a dispneia na anteflexão do tórax — flexopneia — foi descrita entre os pacientes com insuficiência cardíaca.
Objetivo: Estimar a associação da dispneia aos esforços, ortopneia, dispneia paroxística noturna e flexopneia com as doenças crônicas não transmissíveis e, especialmente, com a insuficiência cardíaca e seus fenótipos na atenção primária.
Métodos: Estudo transversal que incluiu 633 indivíduos de 45-99 anos, sorteados entre os cadastrados no programa Médico de Família de Niterói, Brasil. Os participantes foram submetidos a questionário estruturado, avaliação clínica, exames laboratoriais, eletrocardiograma e ecocardiograma, em único dia.
Resultados: A dispneia paroxística noturna e a flexopneia apresentaram associação com a insuficiência cardíaca antes do ajuste (ORb = 2,42; IC 95% = 1,10-5,29 e ORb = 2,59; IC 95% = 1,52-4,44, respectivamente). Nos modelos múltiplos, a doença pulmonar obstrutiva crônica, *angina pectoris* e o infarto do miocárdio não mostraram associação com a flexopneia.
Conclusão: A flexopneia foi a única que não se associou com as doenças respiratórias e as doenças coronarianas. Mesmo após o controle pela depressão e índice de massa corporal, manteve associação com a insuficiência cardíaca e com a insuficiência cardíaca com fração de ejeção preservada, mostrando-se como um sintoma promissor para diferenciar a insuficiência cardíaca dos outros dois grupos de doença.

Introduction

Dyspnea is frequently reported by the elderly, with an estimated prevalence of 20-60%.[1,2] It is the symptom most commonly reported by patients with heart failure (HF),[3,4] although with low specificity, since it is also frequent in prevalent conditions such as chronic obstructive pulmonary disease (COPD), depression, obesity, anemia and coronary artery disease.[2]

The pathophysiology of dyspnea is complex, with various etiologies and mechanisms.[5–8] Among the different types of dyspnea, the most common are exertional dyspnea, paroxysmal nocturnal dyspnea (PND) and orthopnea.[9–11] A new type has recently been described in patients with HF: 'bendopnea' (shortness of breath when bending forward),[12] which is associated with an increase in echocardiographic indices of left-sided filling pressures.[13]

The aim of the present study was to determine the association of exertional dyspnea, orthopnea, PND and bendopnea with chronic disease, especially HF, and their phenotypes in primary care.

Methods

This cross-sectional study is part of the DIGITALIS study and included 633 individuals aged between 45 and 99 years enrolled in a primary care program in Niteroi, Rio de Janeiro state, Brazil. The individuals invited to participate were selected according to previously established methods to be representative of the population under study. Data were collected between July 2011 and December 2012. Selected individuals were seen at their nearest health center, where they completed a questionnaire and underwent a clinical, anthropometric and nutritional assessment, blood pressure (BP) measurement, electrocardiogram and echocardiogram, and blood and urine samples were collected for laboratory tests, all on the same day. The study design and the results of the main study have been previously published.[14]

BP was measured using an Omron HEM-711 HC14 monitor, three measurements being taken at 1-min intervals with the subject seated and arm supported at the level of the heart. If the difference between any measurements was greater than

5 mmHg a fourth reading was taken. The first measurement was discarded and the mean of the others was used in the analysis.[15]

Individuals with hypertension were defined as those who answered affirmatively to question 14.4 of the DIGITALIS questionnaire, were under antihypertensive medication, or had mean systolic blood pressure (SBP) ≥140 mmHg or mean diastolic blood pressure (DBP) ≥90 mmHg. Patients previously diagnosed as hypertensive were considered to be controlled if they had BP <140/90 mmHg.[15]

Tissue Doppler imaging (TDI) was performed on an Acuson Cypress 20 (Siemens) or an Esaote AU3 Partner by two experienced echocardiographers who were blinded to the results of other exams, following the American Society of Echocardiography/European Association of Electrocardiography guidelines for chamber quantification.[16]

Systolic function was assessed by measuring left ventricular (LV) ejection fraction (LVEF) by Simpson's method and longitudinal strain (S'). Left atrial volume was determined by the biplane disc method (modified Simpson's rule) in apical 4- and 2-chamber views at end-systole and indexed to body surface area. Diastolic function parameters were assessed as the mean of five consecutive cardiac cycles. Early (E) and late (A) transmitral flow and E-wave deceleration time were calculated and myocardial relaxation velocity during early diastole (E') was measured by TDI in the septal segment of the mitral annulus.[16]

The study endpoints were the four types of dyspnea. They were considered to be present if the answers to the following questions were affirmative: (1) ''Do you feel breathless on exertion?'' (exertional dyspnea); (2) ''Do you feel breathless when lying down?'' (orthopnea); (3) ''Do you wake up at night feeling breathless after being asleep for several hours?'' (PND); and (4) ''Do you find it difficult to bend over or kneel?'' with the answers ''Slightly difficult'' or ''Very difficult'' (bendopnea).

A diagnosis of HF with reduced ejection fraction (HFrEF) was made in patients with a history of HF, or signs and symptoms of HF, and LVEF <50%.[17] A diagnosis of HF with preserved ejection fraction (HFpEF) was made in patients with a history of HF and LVEF ≥50% and diastolic dysfunction.[18]

HFpEF was defined in accordance with the criteria of the European Society of Cardiology as the presence of signs or symptoms of HF, LVEF ≥50%, LV end-diastolic volume index <97 ml/m^2, and evidence of diastolic dysfunction.[17] Diastolic dysfunction was defined as E/E' ratio >15 on TDI; if E/E' is suggestive of diastolic dysfunction (8-15), other echocardiographic parameters should be used to confirm the diagnosis such as LV mass index (≥122 and ≥149 g/m^2 for women and men, respectively), left atrial volume index (≥40 ml/m^2), or E/A ratio <0.5 with E deceleration time >280 ms. An electrocardiogram showing atrial fibrillation together with E/E' ratio 8-15 also confirms a diagnosis of HFpEF.[17,18]

As well as those diagnosed with HFrEF on the basis of a history of HF and LVEF <50%, individuals without a history of HF, but with signs and symptoms of HF at enrollment in the study, New York Heart Association class >II, B-type natriuretic peptide >35 pg/ml and LVEF <50%, were also considered to have HFrEF.

Table 1 Demographic and clinical characteristics of the study population.

	n	(%)
Female	391	61.8
Age (years)		
≥70	122	19.3
<70	511	80.7
Skin color		
Non-white	396	63.3
White	230	36.7
Education		
4 years or less	269	42.6
5 years or more	362	57.4
Monthly income		
<€278.77	470	75.6
>€278.77	152	24.4
BMI (kg/m^2)		
≥30	190	30.2
<30	439	69.8
Waist circumference (cm)		
≥94 men, ≥80 women	471	74.4
<94 men, <80 women	157	24.8
Anemia	63	10.2
COPD	22	3.5
Depression	138	21.9
Hypertension	460	72.7
Diabetes	157	24.8

Anemia: hemoglobin <13 g/dl for men and <12 g/dl for women; BMI: body mass index; COPD: chronic obstructive pulmonary disease.

COPD was defined as a previous history of the disease reported by the patient during the assessment in response to the question ''Has any doctor ever told you that you have...?'' Anemia was defined as hemoglobin <13 g/dl for men and <12 g/dl for women.[19] The Patient Health Questionnaire-9,[20] validated for use in Brazil,[21] was used to identify patients with depression, defined as those with a score of 10, 15 or 20 (moderate, moderately severe, or severe depression).

Subjects' weight and height were measured to calculate their body mass index (BMI) (weight in kg divided by height in m squared), with obesity defined as BMI ≥30 kg/m^2.[22] Subjects who answered affirmatively to the question ''Has any doctor ever told you that you have hypertension (high blood pressure)?'', were under antihypertensive medication, or had mean SBP ≥140 mmHg or mean DBP ≥90 mmHg, were classified as hypertensive.[15] Diabetes was defined as a previous history as shown by a positive reply to the question ''Has any doctor ever told you that you have diabetes (high blood sugar)?'', fasting blood glucose of ≥126 mg/dl, or reported use of oral antidiabetic medication and/or insulin.[23]

Statistical analysis

The statistical analysis was performed using SPSS version 21 (IBM SPSS Statistics, Chicago, IL, USA). Groups were compared using the chi-square test, with continuity correction when necessary, or Fisher's exact test. The results were expressed as unadjusted and adjusted odds ratios (OR) and 95% confidence intervals (CI) estimated by logistic regression. A p value <0.05 was considered statistically significant.

The study protocol was approved by the research ethics committee of the Antônio Pedro School of Medicine/University Hospital under the number CAAE: 0077.0.258.000-10.

Results

The study included 633 individuals enrolled in a primary care program. Most were women (61.8%), aged between 45 and 69 years (80.7%), with monthly income below €278.77 (75.6%), and hypertensive (72.7%) (Table 1).

Dyspnea was present in 43.8% of the subjects. The most common types were exertional dyspnea (26.5%) and bendopnea (26.2%); the prevalence of orthopnea was 8.8% and of PND 7.1%.

Tables 2 and 3 show the unadjusted ORs for exertional dyspnea, orthopnea, PND and bendopnea according to comorbidities. COPD was associated with exertional dyspnea, orthopnea and PND, but not with bendopnea.

Table 2 Unadjusted odds ratios for exertional dyspnea and orthopnea according to comorbidities.

	Exertional dyspnea			Orthopnea		
	Yes, n (%)	No, n (%)	OR (95% CI)	Yes, n (%)	No, n (%)	OR (95% CI)
BMI (kg/m²)			1.69 (1.16-2.46)***			1.69 (0.96-2.97)*
≥30	65 (34.2)	125 (65.8)		23 (12.1)	167 (87.9)	
<30	103 (23.5)	336 (76.5)		33 (7.5)	406 (92.5)	
WC (cm)			1.23 (0.81-1.88)			1.78 (0.85-3.72)
≥94 men, ≥80 women	130 (27.6)	341 (72.4)		46 (9.8)	425 (90.2)	
<94 men, <80 women	37 (23.6)	120 (76.4)		9 (5.7)	148 (94.3)	
Anemia			0.85 (0.46-1.57)			0.31 (0.07-1.30)*
Yes	15 (23.8)	48 (76.2)		2 (3.2)	61 (96.8)	
No	148 (26.7)	406 (73.3)		53 (9.6)	501 (90.4)	
COPD			5.19 (2.13-12.61)***			5.35 (2.08-13.74)***
Yes	14 (63.6)	8.0 (36.4)		7 (31.8)	15 (68.2)	
No	154 (25.2)	457 (74.8)		49 (8.0)	562 (92.0)	
Depression			4.19 (2.80-6.25)***			4.03 (2.28-7.11)***
Yes	70 (50.7)	68 (49.3)		27 (19.6)	111 (80.4)	
No	97 (19.7)	395 (80.3)		28 (5.7)	464 (94.3)	
Hypertension			0.88 (0.59-1.30)			1.03 (0.55-1.91)
Yes	119 (25.9)	341 (74.1)		41 (8.9)	419 (91.1)	
No	49 (28.3)	124 (71.7)		15 (8.7)	158 (91.3)	
Diabetes			1.15 (0.76-1.71)			1.35 (0.74-2.47)
Yes	45 (28.7)	112 (71.3)		17 (10.8)	140 (89.2)	
No	123 (25.9)	352 (74.1)		39 (8.2)	436 (91.8)	
HF			1.29 (0.73-2.26)			1.81 (0.84-3.90)
Yes	20 (31.3)	44 (68.8)		9 (14.1)	55 (85.9)	
No	148 (26.0)	421 (74.0)		47 (8.3)	522 (91.7)	
HFpEF			1.28 (0.61-2.68)			2.26 (0.89-5.72)*
Yes	11 (31.4)	24 (68.6)		6 (17.1)	29 (82.9)	
No	157 (26.3)	441 (73.7)		50 (8.4)	548 (91.6)	
HFrEF			1.25 (0.56-2.82)			1.20 (0.35-4.09)
Yes	9 (31.0)	20 (69.0)		3 (10.3)	26 (89.7)	
No	59 (26.3)	445 (73.7)		53 (8.8)	551 (91.2)	

Anemia: hemoglobin <13 g/dl for men and <12 g/dl for women; BMI: body mass index; COPD: chronic obstructive pulmonary disease; HF: heart failure; HFpEF: heart failure with preserved ejection fraction; HFrEF: heart failure with reduced ejection fraction; OR: unadjusted odds ratio; WC: waist circumference.

* p≥0.05 and <0.1.

*** p<0.01.

Table 3 Unadjusted odds ratios for paroxysmal nocturnal dyspnea and bendopnea according to comorbidities.

	Paroxysmal nocturnal dyspnea			Bendopnea		
	Yes, n (%)	No, n (%)	OR (95% CI)	Yes, n (%)	No, n (%)	OR (95% CI)
BMI (kg/m²)			0.96 (0.49-1.89)			2.06 (1.42-2.99)***
≥30	13 (6.8)	177 (93.2)		69 (36.5)	120 (63.5)	
<30	31 (7.1)	408 (92.9)		95 (21.8)	341 (78.2)	
WC (cm)			1.54 (0.70-3.39)			1.95 (1.23-3.10)***
≥94 men, ≥80 women	36 (7.6)	435 (92.4)		135 (28.9)	332 (71.1)	
<94 men, <80 women	8 (5.1)	149 (94.9)		27 (17.2)	130 (82.8)	
Anemia			0.62 (0.18-2.08)			1.56 (0.90-2.71)
Yes	3.0 (4.8)	60 (95.2)		22 (34.9)	41 (65.1)	
No	41 (7.4)	513 (92.6)		140 (25.5)	408 (74.5)	
COPD			4.19 (1.17-11.96)***			1.77 (0.72-4.36)
Yes	5 (22.7)	17 (77.3)		8 (38.1)	13 (61.9)	
No	40 (6.5)	571 (93.5)		156 (25.7)	450 (74.3)	
Depression			2.68 (1.42-5.06)***			3.71 (2.48-5.55)***
Yes	65 (34.2)	125 (65.8)		66 (48.2)	71 (51.8)	
No	103 (23.5)	336 (76.5)		98 (20.0)	392 (80.0)	
Hypertension			1.03 (0.52-2.05)			1.62 (1.05-2.48)**
Yes	33 (7.2)	427 (92.8)		130 (28.6)	325 (71.4)	
No	12 (6.9)	161 (93.1)		34 (19.8)	138 (80.2)	
Diabetes			1.25 (0.63-2.44)			1.92 (1.30-2.85)***
Yes	13 (8.3)	144 (91.7)		56 (36.4)	98 (63.6)	
No	32 (6.7)	443 (93.3)		108 (22.9)	364 (77.1)	
HF			2.42 (1.10-5.29)**			
Yes	9 (14.1)	55 (85.9)		28 (45.2)	34 (54.8)	2.59 (1.52-4.44)***
No	36 (6.3)	533 (93.7)		136 (24.1)	429 (75.9)	
HFpEF			2.32 (0.85-6.31)*			
Yes	5 (14.3)	30 (85.7)		17 (51.5)	16 (48.5)	3.23 (1.59-6.55)***
No	40 (6.7)	558 (93.3)		147 (24.7)	447 (75.3)	
HFrEF			2.19 (0.73-6.61)			
Yes	4 (13.8)	25 (86.2)		11 (37.9)	18 (62.1)	1.77 (0.82-3.84)
No	41 (6.8)	563 (93.2)		153 (25.6)	445 (74.4)	

Anemia: hemoglobin <13 g/dl for men and <12 g/dl for women; BMI: body mass index; COPD: chronic obstructive pulmonary disease; HF: heart failure; HFpEF: heart failure with preserved ejection fraction; HFrEF: heart failure with reduced ejection fraction; OR: unadjusted odds ratio; WC: waist circumference.

* p≥0.05 and <0.1.

** p<0.05 and ≥0.01.

*** p<0.01.

Depression was the only comorbidity associated with all types of dyspnea, with ORs ranging between 2.68 and 4.19. HF was significantly associated with PND and bendopnea: HFpEF with all types except exertional dyspnea but HFrEF with none (although it presented an OR >2 with PND, probably due to the small number of subjects with this condition).

Table 4 shows the results of multiple logistic regression analysis of all variables that reached p<0.1 in bivariate analysis. Separate models were constructed for HF and HFpEF. After adjustment, HF only maintained an association with PND (OR 3.68, 95% CI 1.43-9.46), while the association with bendopnea (OR 1.84) was without statistical significance (p<0.1). HFpEF lost its significant association with the three types of dyspnea included in the logistic regression analysis following adjustment, with ORs of 3.15 for PND and 2.04 for bendopnea (p<0.1). Depression was strongly associated (p<0.05) in the five logistic regression models, while COPD showed a strong association with orthopnea (OR 6.86) when HFpEF was included but was associated with PND (OR >2) for both models (HF and HFpEF). Age was a protective factor against PND and was not associated with bendopnea.

Discussion

In the present study, mapping the different types of dyspnea to common morbidities in adults and the elderly

Table 4 Adjusted odds ratios for orthopnea, paroxysmal nocturnal dyspnea and bendopnea.

	HF		HFpEF		
	PND OR (95% CI)	Bendopnea OR (95% CI)	Orthopnea OR (95% CI)	PND OR (95% CI)	Bendopnea OR (95% CI)
HFpEF			1.88 (0.65-5.47)	3.15 (0.93-10.66)*	2.04 (0.89-4.66)*
HF	3.68 (1.43-9.46)***	1.84 (0.97-3.48)*			
Gender		0.77 (0.50-1.19)	0.46 (0.20-1.06)*		0.80 (0.52-1.23)
Age	0.22 (0.06-0.75)**	1.27 (0.76-2.13)		0.27 (0.08-0.90) **	1.31 (0.79-2.19)
Education		1.47 (0.97-2.21)*			1.46 (0.97-2.20)*
Income	2.36 (0.92-6.05) *	1.50 (0.91-2.48)	2.83 (1.12-7.18)**	2.31 (0.91-5.87)*	1.52 (0.92-2.51)*
BMI $\geq$30 kg/m^2		1.71 (1.13-2.60)**	1.60 (0.85-3.01)		1.73 (1.14-2.63)**
WC		1.30 (0.76-2.23)			
Anemia			0.25 (0.05-1.17)*		
COPD	2.68 (0.81-8.86)*		6.86 (2.13-22.12)***	2.88 (0.88-9.41)*	
Depression	2.14 (1.08-4.20)**	3.54 (2.29-5.46)***	3.00 (1.60-5.63)***	2.13 (1.09-4.18)**	3.51 (2.27-5.41)***
Hypertension		1.15 (0.71-1.87)			1.18 (0.73-1.90)
Diabetes		1.78 (1.16-2.75)**			1.76 (1.14-2.71)**

Anemia: hemoglobin <13 g/dl for men and <12 g/dl for women; BMI: body mass index; COPD: chronic obstructive pulmonary disease; HF: heart failure; HFpEF: heart failure with preserved ejection fraction; HFrEF: heart failure with reduced ejection fraction; OR: adjusted odds ratio; PND: paroxysmal nocturnal dyspnea; WC: waist circumference.

* p$\geq$0.05 and <0.1.

** p<0.05 and $\geq$0.01.

*** p<0.01.

revealed a pattern. COPD showed a strong unadjusted association with exertional dyspnea, orthopnea and PND, and a non-significant association with bendopnea. The opposite was true for HF and HFpEF, which showed strong unadjusted associations with bendopnea. Another interesting finding was the weak association of HFrEF with all types of dyspnea except PND. There is plentiful evidence in the literature that COPD as well as HF is a common cause of dyspnea.[24]

PND is one of the major Framingham criteria for a diagnosis of HF and is also one of the Boston criteria.[25,26] Dyspnea is caused by the decreased ability of the heart to fill and empty, producing elevated pressures in the pulmonary blood vessels.[27] Albert et al.[28] assessed 276 patients with HF and reported a prevalence of self-reported PND of 23.6%, compared to 14.1% in the present study. The greater prevalence of PND observed by Albert et al. may be explained by the fact that their study included both outpatients and hospitalized patients, unlike our study population, which consisted exclusively of non-hospitalized volunteers who were not necessarily ill.

The study by Thibodeau et al.[12] of 102 individuals with HFrEF found a prevalence of bendopnea of 29%, compared to 37.9% in our study. They showed that patients with bendopnea had a hemodynamic profile characterized by greater LV filling pressures and reduced cardiac index. The difference between their results and ours may be explained by the fact that we only used answers to the question ''Do you find it difficult to bend over or kneel?'' to diagnose bendopnea, a less specific method than that used by Thibodeau et al., who asked whether subjects reported shortness of breath within 30 s of bending forward such as when putting on their shoes.

Thibodeau et al. did not investigate patients with HFpEF. In our study, the prevalence of bendopnea in these patients was greater than in HFrEF (51.5% vs. 37.9%), and this association persisted in multivariate analysis, although with a p value between 0.05 and 0.1.

Depression was the only variable in the univariate analysis that showed a strong association with all four types of dyspnea and with three types in the multivariate analysis. There is ample evidence of a link between anxiety and depression and respiratory symptoms,[29,30] but the cause/effect relationship between psychological factors and dyspnea is not fully understood.[31] Some studies indicate that dyspnea can trigger psychiatric disorders, while others suggest that psychiatric disorders, particularly depression, intensify the subjective experience of dyspnea.[31–34]

Although they differ in certain aspects, the pathophysiological processes and the clinical signs and symptoms of COPD and HF often overlap,[35] as do the terms used by COPD and HF patients to describe their shortness of breath, and the frequency with which they experience dyspnea is similar.[7,36,37] This can make it difficult to distinguish between the two diseases. In the present study, the self-reported prevalences of HF and COPD were low (8.2% and 3.5%, respectively), and only three (5.8%) of the 52 participants who stated they had been previously diagnosed with HF had also been diagnosed with COPD. This is in agreement with community studies that report prevalences of COPD in HF patients ranging between 7 and 13%.[35]

In the present study, subjects with BMI $\geq$30 kg/m^2 were more likely to present exertional dyspnea or bendopnea in univariate analysis, an association that was only

maintained with bendopnea in multivariate analysis. Furthermore, waist circumference of ≥94 cm for men and ≥80 cm for women was significantly associated with bendopnea in univariate analysis. An association between obesity and dyspnea is reported in the literature.[38] The mechanisms involved in dyspnea in the obese include reduced end-expiratory lung volume[39] and increased respiratory work for all levels of exertion.[40] The patients with bendopnea in the study by Thibodeau et al.[12] also had higher BMI than those without, which may have increased their discomfort when bending over. Similarly, in the present study there was a greater prevalence of BMI ≥30 kg/m^2 in subjects with bendopnea than with other types of dyspnea. Invasive hemodynamic monitoring by Thibodeau et al. showed that bending over increased venous return and filling pressures, causing shortness of breath. The authors pointed out that obese subjects presented higher filling pressures before leaning over, and thus were more likely to reach the pressure threshold that would cause symptoms.[12]

The present study used self-reporting to determine certain important variables such as the presence of COPD. Self-reporting of chronic diseases is generally reasonably accurate,[41–43] and using previous diagnoses reported by patients themselves is a method that has been validated in clinical trials in other countries, in both men and women.[44,45] In Brazil, a household survey on risk behavior and morbidity from non-communicable diseases used self-reporting to establish the prevalence of ischemic heart disease in the population.[46] An important advantage of this method is that it facilitates comparisons with other countries, since the considerable differences in health care systems between countries mean that data from medical records are often not easily comparable.[43] Studies have found self-reported prevalences of COPD to be fairly reliable but probably underestimated.[47] In general, it can be stated that the findings of the present study are reasonably reproducible.

The study has certain limitations. Its cross-sectional nature makes it impossible to establish whether dyspnea was the result of HF or of other comorbidities. It should also be borne in mind that the definition of bendopnea used differs from that of Thibodeau et al., which is more specific; in the present study individuals with musculoskeletal problems may have been incorrectly classified as having bendopnea.

Furthermore, the question ''Do you feel breathless on exertion?'' did not take the time factor into account and thus may have excluded individuals with this symptom who at the time of the survey were compensated and thus less symptomatic.

Diagnosing COPD without performing objective respiratory tests is another limitation, although these individuals were being followed by their family physician and would generally have been aware of their condition.

The criteria used to classify subjects as having diabetes did not include a second measurement of blood glucose, which may have led to overestimation of its prevalence.

Since only 22 participants presented COPD, 35 HFpEF and 29 HFrEF, the lack of statistical significance for some findings may reflect inadequate statistical power.

Conclusions

Bendopnea was the only type of dyspnea not linked to respiratory disease or coronary heart disease. Even after adjusting for depression and BMI, the association remained with HF and HFpEF, and bendopnea thus appears to be a promising symptom to differentiate heart failure from the other two disease groups. These associations could also help improve triage of patients with suspected HF and referral for further investigation.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

Conflicts of interest

The authors have no conflicts of interest to declare.

References

1. Tessier JF, Nejjari C, Letenneur L, et al. Dyspnea and 8-year mortality among elderly men and women: the PAQUID cohort study. Eur J Epidemiol. 2001;17:223–9.
2. Landahl S, Steen B, Svanborg A. Dyspnea in 70-year-old people. Acta Med Scand. 1980.
3. Ahmed A, Allman RM, Aronow WS, et al. Diagnosis of heart failure in older adults: predictive value of dyspnea at rest. Arch Gerontol Geriatr. 2004;38:297–307.
4. Friedman MM. Older adults' symptoms and their duration before hospitalization for heart failure. Heart Lung. 1997;26:169–76.
5. Vuckovic KM, DeVon HA, Piano MR. Measurement of dyspnea in ambulatory African Americans with heart failure and a preserved or reduced ejection fraction. Cardiovasc Nurs. 2014.
6. West RL, Hernandez AF, O'Connor CM, et al. A review of dyspnea in acute heart failure syndromes. Am Heart J. 2010;160:209–14.
7. Simon PM, Schwartzstein RM, Weiss JW, et al. Distinguishable types of dyspnea in patients with shortness of breath. Am Rev Respir Dis. 1990;142:1009–14.
8. Mahler DA, Harver A, Lentine T, et al. Descriptors of breathlessness in cardiorespiratory diseases. Am J Respir Crit Care Med. 1996;154:1357–63.
9. Ho KK, Anderson KM, Kannel WB, et al. Survival after the onset of congestive heart failure in Framingham Heart Study subjects. Circulation. 1993;88:107–15.
10. Fan X, Meng Z. The mutual association between depressive symptoms and dyspnea in Chinese patients with chronic heart failure. Eur J Cardiovasc Nurs. 2014.

11. Mukerji V. Dyspnea, orthopnea, and paroxysmal nocturnal dyspnea. In: Walker HK, Hall WD, Hurst JW, editors. Clinical methods: the history, physical, and laboratory examinations. 3rd ed. Boston: Butterworths; 1990 [chapter 11].
12. Thibodeau JT, Turer AT, Gualano SK, et al. Characterization of a novel symptom of advanced heart failure: bendopnea. JACC Heart Fail. 2014;2:24–31.
13. Brandon N, Mehra MR. ''Flexo-dyspnea'': a novel clinical observation in the heart failure syndrome. J Heart Lung Transplant. 2013;32:844–5.
14. Rosa MLG, Mesquita ET, Jorge AJ, et al. Prevalence of chronic diseases in individuals assisted by the family health program in Niteroi, Brazil: evaluation of selection bias and protocol. Int J Med Res Health Sci. 2015;4:587–96.
15. Sociedade Brasileira de Cardiologia/Sociedade Brasileira de Hipertensão/Sociedade Brasileira de Nefrologia. VI Diretrizes Brasileiras de Hipertensão. Arq Bras Cardiol. 2010;95 Suppl. 1:1–51.
16. Jorge AJ, Freire MD, Ribeiro ML, et al. Utility of B type natriuretic peptide measurement in outpatients with heart failure with preserved ejection fraction. Rev Port Cardiol. 2013;32:647–52.
17. Dickstein K, Cohen-Solal A, Filippatos G, et al. ESC guidelines for the diagnosis and treatment of acute and chronic heart failure 2008: The Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2008 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association of the ESC (HFA) and endorsed by the European Society of Intensive Care Medicine (ESICM). Eur Heart J. 2008;29:2388–442.
18. Paulus WJ, Tschope C, Sanderson JE, et al. How to diagnose diastolic heart failure: a consensus statement on the diagnosis of heart failure with normal left ventricular ejection fraction by the Heart Failure and Echocardiography Associations of the European Society of Cardiology. Eur Heart J. 2007;28:2539–50.
19. Felker GM, Shaw LK, Stough WG, et al. Anemia in patients with heart failure and preserved systolic function. Am Heart J. 2006;151:457–62.
20. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med. 2001;16:606–13.
21. Santos IS, Tavares BF, Munhoz TN, et al. Sensitivity and specificity of the Patient Health Questionnaire-9 (PHQ-9) among adults from the general population. Cad Saude Pública. 2013;29:1533–43.
22. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organ Tech Rep Ser. 1995;854:1–452.
23. American Diabetes Association. Standards of medical care in diabetes – 2011. Diabetes Care. 2011;34 Suppl. 1:S11–61.
24. Shiber JR, Santana J. Dyspnea. Med Clin N Am. 2006;90:453–79.
25. McKee PA, Castelli WP, McNamara PM, et al. The natural history of congestive heart failure: the Framingham study. N Engl J Med. 1971;285:1441–6.
26. Carlson KJ, Lee DC, Goroll AH, et al. An analysis of physicians' reasons for prescribing long-term digitalis therapy in outpatients. J Chronic Dis. 1985;38:733–9.
27. Bozkurt B, Mann DL. Cardiology patient page. Shortness of breath. Circulation. 2003;108:e11–3.
28. Albert N, Trochelman K, Li J, et al. Signs and symptoms of heart failure: are you asking the right questions? Am J Crit Care. 2010;19:443–52.
29. Katon WJ, Richardson L, Lozano P, et al. The relationship of asthma and anxiety disorders. Psychosom Med. 2004;66:349–55.
30. Herr JK, Salyer J, Lyon DE, et al. Heart failure symptom relationships: a systematic review. J Cardiovasc Nurs. 2014;29:416–22.
31. Scano G, Gigliotti F, Stendardi L, et al. Dyspnea and emotional states in health and disease. Respir Med. 2013;107:649–55.
32. Martínez-Moragón E, Perpiñá M, Belloch A, et al. Determinants of dyspnea in patients with different grades of stable asthma. J Asthma. 2003;40:375–82.
33. Neuman A, Gunnbjörnsdottir M, Tunsäter A, et al. Dyspnea in relation to symptoms of anxiety and depression: a prospective population study. Respir Med. 2006;100:1843–9.
34. Tiller J, Pain M, Biddle N. Anxiety disorder and perception of inspiratory resistive loads. Chest. 1987;91:547–51.
35. Hawkins NM, Petrie MC, Jhund PS, et al. Heart failure and chronic obstructive pulmonary disease: diagnostic pitfalls and epidemiology. Eur J Heart Fail. 2009;11:130–9.
36. Caroci Ade S, Lareau SC. Descriptors of dyspnea by patients with chronic obstructive pulmonary disease versus congestive heart failure. Heart Lung. 2004;33:102–10.
37. Locke E, Thielke S, Diehr P, et al. Effects of respiratory and non-respiratory factors on disability among older adults with airway obstruction: the Cardiovascular Health Study. COPD. 2013;10:588–96.
38. Bowden JA, To TH, Abernethy AP, et al. Predictors of chronic breathlessness: a large population study. BMC Public Health. 2011;12:33.
39. Babb TG, Wyrick BL, DeLorey DS, et al. Fat distribution and end-expiratory lung volume in lean and obese men and women. Chest. 2008;134:704–11.
40. Kress JP, Pohlman AS, Alverdy J, et al. The impact of morbid obesity on oxygen cost of breathing (VO(2RESP)) at rest. Am J Respir Crit Care Med. 1999;160:883–6.
41. Lagaay AM, van der Meij JC, Hijmans W. Validation of medical history taking as part of a population based survey in subjects aged 85 and over. BMJ. 1992;304:1091–2.
42. Midthjell K, Holmen J, Bjørndal A, et al. Is questionnaire information valid in the study of a chronic disease such as diabetes? The Nord-Trøndelag diabetes study. J Epidemiol Community Health. 1992;46:537–42.
43. Kehoe R, Wu SY, Leske MC, et al. Comparing self-reported and physician-reported medical history. Am J Epidemiol. 1994;139:813–8.
44. Haapanen N, Miilunpalo S, Pasanen M, et al. Agreement between questionnaire data and medical records of chronic diseases in middle-aged and elderly Finnish men and women. Am J Epidemiol. 1997;145:762–9.
45. Lampe FC, Walker M, Lennon LT, et al. Validity of a self-reported history of doctor-diagnosed angina. J Clin Epidemiol. 1999;52:73–81.
46. Ministério da Saúde, Secretaria de Vigilância em Saúde, Secretaria de Atenção à Saúde, Instituto Nacional de Câncer, Coordenação de Prevenção e Vigilância. Inquérito domiciliar sobre comportamentos de risco e morbidade referida de doenças e agravos não-transmissíveis: Brasil, 15 capitais e Distrito Federal, 2002–2003. Rio de Janeiro: INCA; 2004.
47. Barr RG, Herbstman J, Speizer FE, et al. Validation of self-reported chronic obstructive pulmonary disease in a cohort study of nurses. Am J Epidemiol. 2002;155.