Journal of Asthma

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/ijas20

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To cite this article: Wendy Maltinsky, Sally Henton, Giulia Spaltro, Stephen Fowler, Rekha Chaudhuri, Claire Higgs, David Boiskin & Stephen Preece (07 Sep 2024): Illness perceptions, symptom severity and psychosocial outcomes in adults with dysfunctional breathing, Journal of Asthma, DOI: 10.1080/02770903.2024.2397656

To link to this article: https://doi.org/10.1080/02770903.2024.2397656

Published online: 07 Sep 2024.

JOURNAL OF ASTHMA
https://doi.org/10.1080/02770903.2024.2397656

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Illness perceptions, symptom severity and psychosocial outcomes in adults with dysfunctional breathing

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ABSTRACT

Background: People with dysfunctional breathing (DB) experience symptoms such as air hunger and breathing pattern irregularities. The condition is often comorbid with other respiratory conditions, as well as anxiety and depression. Illness perceptions, the beliefs an individual has of an illness may explain health and wellbeing outcomes.

Methods: In this cross-sectional study we examined the illness perceptions of those diagnosed with DB, symptom severity, and psychosocial outcomes of depression, anxiety, and impact on daily living. Data were analyzed using tests of comparison and regression analysis.

Results: 82 people diagnosed with DB completed the brief illness perception questionnaire, the Nijmegen symptoms questionnaire, and questionnaires measuring mood and impact on daily living. The illness perceptions of those with DB were overall negative. There was a positive correlation between illness perceptions and mood, indicating that the stronger the beliefs that individuals had that DB is a serious condition, the more negative their mood. Illness perceptions significantly predicted psychosocial outcomes, even when controlling for demographic factors and symptom severity (depression: adj. R^2=.352, F(10,51)=4.32, p<.001; anxiety: adj. R^2=.40, F(11,47)=4.55, p<.001; impact on daily living: adj. R^2= .33, F(8,53)=4.79, p<.001).

Conclusions: This is the first study to examine illness perceptions held by those diagnosed with DB. Our study found significant relationships between illness perceptions and psychosocial outcomes. It is possible that psychological interventions that target illness perceptions may also improve outcomes.

ARTICLE HISTORY
Received 5 December 2023
Revised 6 August 2024
Accepted 24 August 2024

KEYWORDS
psychosocial; illness perceptions; common sense self-regulatory model; dysfunctional breathing; breathing pattern disorder

Introduction

Dysfunctional breathing (DB) is a condition in which individuals experience breathing pattern irregularities either without organic cause, or in excess of an expected response to a respiratory condition (1,2). It is characterized by variability and irregularity in the rate, flow and volume of breathing (3). Predominant DB symptoms of dyspnea and dizziness are frequently associated with conditions of asthma, chronic obstructive pulmonary disease (COPD) or panic disorder. DB is also often comorbid with these conditions (2); as many as 42% of people who have an asthma diagnosis also have DB but the DB symptoms are masked by those of asthma (4,5). According to a UK general practice survey 1 in 10 people may be experiencing DB (6). Overall, understanding of the condition amongst patients and clinicians is generally poor (2).

The considerable comorbidity profile of DB, overlap in symptoms with other respiratory or psychological conditions and the general lack of understanding of the condition contribute to difficulties in its accurate diagnosis (2). In the absence of a gold standard assessment of DB (3), misdiagnosis and underdiagnosis is common (2). Diagnostic challenges are further compounded because people with DB can be unaware of their own breathing patterns (1).

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Mis or underdiagnosis may result in individuals receiving either the wrong treatment or inappropriate treatment (7). For instance, misdiagnosis of asthma instead of DB may lead to unnecessary pharmacological treatment, with no improvement in symptoms and increased healthcare costs (7,8). The main therapeutic approach for patients with DB is breathing retraining (3,9), breathing techniques to promote breathing regularity.

Respiratory conditions are frequently comorbid with mood disorders (10,11). Anxiety and/or depression prevalence is estimated at 50% for individuals with severe asthma (11) and at 35.4% and 41.7% respectively for those with COPD (12) This compares with levels of anxiety and depression in a general UK population at roughly 4.65% and 4.12% respectively (13). It is difficult to estimate figures of anxiety and depression for those with DB, as prevalence is unclear, nevertheless, it is apparent that people with DB may experience anxiety and depression at rates at least as high as in other respiratory conditions (4). Mood disorders experienced by people who have DB may be explained by ambiguity of diagnosis, inappropriate treatment, comorbidities (2) and lack of awareness of own breathing pattern (1). The condition-related uncertainty likely impacts how people with DB make sense of and manage their illness.

Health Psychology theories may assist in explaining how the perceptions individuals hold of their illness which in turn may be influenced by uncertainties, will relate to health and psychosocial outcomes. The common sense self-regulatory model (CS-SRM) (14) is particularly appropriate in offering an insight into perceptions (emotions and beliefs) individuals hold of their illness and the relationships these may have with health and wellbeing. According to the CS-SRM, when individuals perceive a health threat such as a diagnosis or symptom detection, this triggers a schematic representation of the illness (15,16). These individualized schemas (mental representations of an event, situation or phenomena) are created from external sources (e.g., websites, social media, peers) and previous personal experiences. Individuals tap into the cognitive and corresponding emotional representation of the illness which combined are called illness perceptions or illness representations. The cognitive representation consists of beliefs across several domains: identity, cause, consequences, timeline, controllability, and coherence. The emotional representation can be fear or alarm (17). These perceptions can have a direct relationship with health and wellbeing as well as an indirect relationship mediated through coping behaviors (18).

A robust relationship has been demonstrated between illness perceptions and outcomes in several long-term conditions (17,19–21). For individuals with COPD, holding a more positive view of the illness, perceiving fewer symptoms and a less intense emotional response corresponds to greater health-related quality of life scores even after controlling for illness severity (21,22); better understanding of their illness correlates with using proactive coping strategies (22). Similarly, in young people with asthma, quality of life scores have been reported as inversely correlated with emotional response intensity, level of concern and symptom perception (23), though it is not clear if severity of illness may be a mediating factor.

Given the evidence presented above, this study aims to understand the illness perceptions for those diagnosed with DB and the relationship with health and psychosocial outcomes.

Methods

Research design

The study used a cross-sectional mixed-method survey design consisting of Likert-scale questions and an open-text question to examine illness perceptions of DB, symptom severity, anxiety, depression and impact on daily living.

Procedure

Recruitment was *via* two routes: specialist respiratory clinics or a database search (Figure 1). Two NHS respiratory physiotherapy clinics (Scotland and Northern England) participated and were requested to contact 200 patients to achieve 109 completed questionnaires, as per power analysis calculations reported below.

Throughout all study communications, patients were advised that participation was sought because of the DB diagnosis they held. Study materials noted the intention to explore perceptions that participants held of DB.

Participants

For study inclusion, participants were required to be UK resident adults (18+), with a clinical diagnosis of DB. Exclusion criteria were: inability to speak/understand English sufficient to read/understand the participant information sheet and provide informed consent.

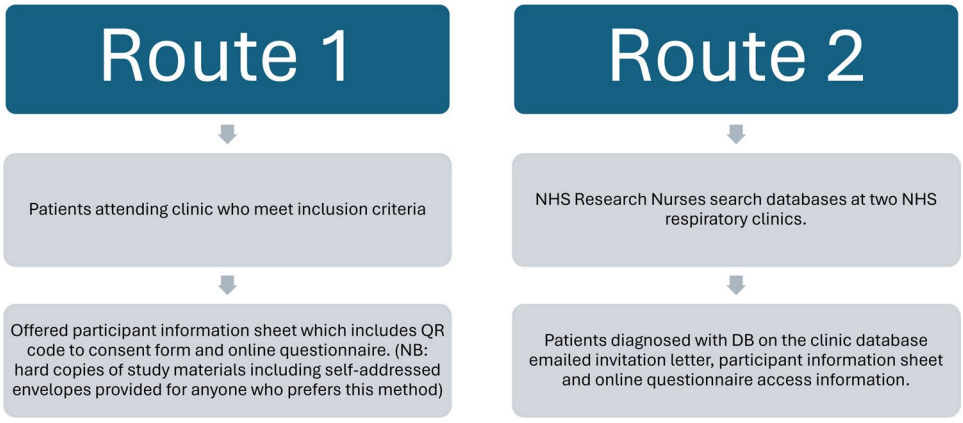

Figure 1. Study design and recruitment processes.

A priori power analysis was conducted using G*Power version 3.1.9.7 (24) to determine minimum sample size required to test the study hypothesis. A sample size of $n = 109$ was required to achieve 80% power for detecting a medium effect, at a significance criterion of α=.05, for tests of comparison and regression analysis.

Measures/questionnaires

Brief illness perception questionnaire (B-IPQ)

The B-IPQ is a 9-item questionnaire (25) assessing cognitive and emotional representations of an illness with scoring ranging from 0–10. Cognitive representations are assessed by single-item questions on illness consequence (no effect on life to severe effect), timeline (illness will continue for a very short time to forever), personal control (absolutely no control over the illness), treatment control (treatment not at all helpful to extremely helpful) and identity ('no symptoms at all' to 'many severe symptoms'). Emotional representations are assessed through one emotion item (not at all affected emotionally by illness to extremely affected emotionally) and one about concern (not at all concerned about the illness to extremely concerned). Illness comprehensibility is assessed by one item (don't understand illness at all to understand illness very clearly). For control (personal and treatment aggregated) and comprehensibility, domains are reverse scored. Higher scores represent higher perceived threat from the illness. An open-text question assesses illness causes with an option to provide three cause beliefs. The Cronbach's alpha for the current study was $\alpha = 0.70$. The B-IPQ measure has not previously been reported in the DB population, however it has demonstrated good test-retest reliability and predictive validity in samples of adults in other respiratory conditions, namely asthma (22) and COPD (17).

Patient health questionnaire 9 (PHQ-9)

The PHQ-9 (26) is a 9-item depression scale asking about mental health within past two weeks (e.g. little interest, feeling tired), with Likert-type responses ranging from 0 (not at all) – 3 (nearly every day). A score between 5–9 indicates mild depression, 10–14 moderate depression, 15–19 moderately severe depression and over 20 is indicator of severe depression (21). The Cronbach's alpha for the original scale was $\alpha = 0.89$ (21) and for the current study $\alpha = 0.89$.

Generalized anxiety disorder 7 (GAD-7)

The GAD-7 (27) is a 7-item scale measuring generalized anxiety disorder. The scale asks about mental health within past two weeks (e.g. worrying too much, feeling nervous) with Likert-type responses ranging from 0 (not at all) – 3 (nearly every day). A score of between 5–9 indicates mild anxiety, 10–14 moderate anxiety, and greater than 15 is indicator of severe anxiety. The Cronbach's alpha for the original scale was $\alpha = 0.89$ (28) and for the current study $\alpha = 0.93$.

Nijmegen questionnaire

The Nijmegen scale is a 16-item abnormal breathing-symptom measure widely utilized to identify individuals with DB (2) on a 5-point Likert-type responses ranging from 0 (never) – 4 (very often) with scores >22 used as a proxy for DB diagnosis (29).

An unresolvable technical complication with the survey platform occurred for item 2 ('tense') in this scale resulting in unavailability of the item data. A decision was taken to impute average scores for the item for all as reported previously (30).

A study assessing the validity of the Nijmegen scale found Cronbach's alpha of $\alpha = 0.80$ (29) and for the current study $\alpha = 0.87$.

Influence on daily living questionnaire (IDL)

The IDL is a non-validated measure assessing breathing problem influences on stress, exercise and everyday life (4,31) which informed the questionnaire used in this study. 5-point Likert response options ranged from 1 (disagree strongly) – 5 (agree strongly); higher scores indicating greater impact of breathing problems on life. The scale was adapted from the original 10 point (32). The Cronbach's alpha for the current study was $\alpha = 0.74$ indicating the adaptation was acceptable. No Cronbach's alpha was available for the original scale.

Analyses

Quantitative statistical analysis was conducted in SPSS version 27. Assumptions of normality were assessed using the Kolmogorov-Smirnov statistic with reference to histogram distributions, while reliability assessment was calculated *via* Cronbach's Alpha coefficient calculations for each employed measurement scale. Correlational analyses were completed between illness perception domains and health and wellbeing outcome measures to explore relationships. The non-parametric Spearman's Rho correlation coefficient was used due to skewed datasets. One-way multivariate analyses were run to compare IPQ scores among those who confirmed diagnosis and those who were uncertain or did not think they had a diagnosis; those who scored ≥23 or <23 (proxy score for DB) in the Nijmegen questionnaire; and to determine the effect of comorbidity of other lung conditions on illness perceptions. Hierarchical multiple regressions were performed for each psychosocial outcome (depression, anxiety and impact on daily living), while controlling for demographic factors and symptom severity. Frequency analysis aggregated number of responses for causes of illness categorized according to lifestyle, psychological causes, natural causes, working conditions, body changes, environmental factors and other causes as previously proposed (33).

Ethical approval

The study was approved by NHS Ethics (IRAS number 304267). All participants provided informed consent.

Results

Sample characteristics

Of the 113 participants who started the survey, 82 responses were completed to 80% or greater and included in analysis. Most participants were female ($n = 55$, 67%), white ($n = 71$, 87%), with a mean age of 49 (SD 15.91, range 18–81) years, and a mean weight of 84.3 (SD 34.9, range 44–317) kg.

Diagnosis and comorbidities

74% of participants confirmed a DB diagnosis, 22% reported being unsure, 4% did not confirm a diagnosis. Descriptive analysis revealed that only one person who responded no/not sure had a symptom severity score below 23, scoring 19, while remaining participants of this category had scores of 23 or above. The range of scores for those confirming diagnosis was 2–45. Lower scores may indicate a well-managed condition (34). The score of 19 fell within the normal range of symptom severity scores for diagnosed participants and it was decided to retain all participants in the analysis.

The majority (56%) who confirmed DB diagnosis had received their diagnosis between 1 -5 years ago, 27% were diagnosed within last 6 months. Additional lung disease diagnoses were reported by 59% of participants (61% of this subset had asthma, 14% COPD, emphysema or chronic bronchitis, the remaining 25% of this subset citing other lung conditions). Heart conditions were indicated by 17%; 38% reported Long COVID. Mental health co-morbidities comprised depression (38%), anxiety (44%), and panic disorder (23%). 21% had three or more co-morbidities.

Symptom severity and psychosocial characteristics

Mean symptom severity measured *via* the Nijmegen scale was 30.8 (SD 11.29) with 78% receiving a score of 23+. Mean depression levels measured *via* the PHQ-9 scale was 12.5 (SD 7.02), with 26% of participants experiencing mild depression, 24% moderate, 17% moderately severe and 20% severe depression. Mean anxiety levels measured *via* the GAD-7 scale was 9.1 (SD 6.60) with 28% experiencing normal levels of anxiety, 31% mild anxiety, 17% moderate and 24% severe anxiety. The mean influence of DB on daily living was 23.5 (SD 3.86) (possible highest score of 30).

Illness perceptions

The mean score for illness perceptions was 51.4 (SD 10.7) (possible highest score of 80). Individual domain mean scores are presented in Figure 2.

The highest mean score was timeline (8.57 SD 2.04), followed by identity (7.24 SD 1.92), concern (7.14 SD 2.57) and consequences (7.10 SD 2.08). Participants perceived DB as a chronic, concerning condition with severe symptoms and substantial life impact. There was low coherence of the illness suggesting limited understanding; personal treatment control was also low indicating perceived limited ability to manage the condition.

There were no associations between how long individuals had been diagnosed with DB and illness perception domains ($p>.05$).

Multivariate analysis of variance highlighted: (i) no significant differences in illness perceptions scores between those who confirmed diagnosis, those who were either uncertain or the 4% who responded 'no' to the DB diagnosis question; (ii) no significant differences in illness perceptions scores between those who scored above or below 23 in symptom severity scale.

48 of the 82 participants reported at least one attribution they perceived as the cause of their DB. Frequency analysis of the first response indicated that most (62.5%) perceived other illnesses (categorized as body changes) including asthma, pain or COPD as the cause; 57% of this category specified COVID or long COVID. 14.5% believed the illness was genetic, while 6% attributed DB to lifestyle factors such as diet and smoking and 8% to environmental factors including weather and pollutants. Altogether 119 attributions were described by 48 participants. Across all of these, other illnesses constituted 53% of the responses; 19% to lifestyle choices and psychological factors (stress, anxiety and panic) were considered a cause in 9% of responses. 37% of those with asthma or asthma and another respiratory condition attributed the cause of their DB to asthma.

A one-way multivariate analysis of variance was run to determine the effect of co-morbid lung conditions on illness perception. All eight domains of the brief-IPQ were assessed. Participants either had only DB ($n=31$) or DB alongside another lung condition ($n=46$) (participants who were unsure whether they had a lung disease were counted as only having DB). As seen in Table 1, participants who had been diagnosed with a lung disease showed higher scores in all illness perception domains than those who only had DB. The differences between having only DB or a co-morbid lung condition on the combined dependent variables was not statistically significant, $F(8,68)=1.77$, $p=.099$; Wilks' $\Lambda=.828$; partial $\eta^2=.172$.

Illness perception domains and health and wellbeing outcomes

Correlational associations between the B-IPQ domains with symptom severity, depression, anxiety and influence on daily living are presented below and summarized in Table 2.

Illness perceptions and symptom severity

Correlational analyses using Spearman's Rho found no significant associations between symptom severity and brief-IPQ domains with the exception of Emotion

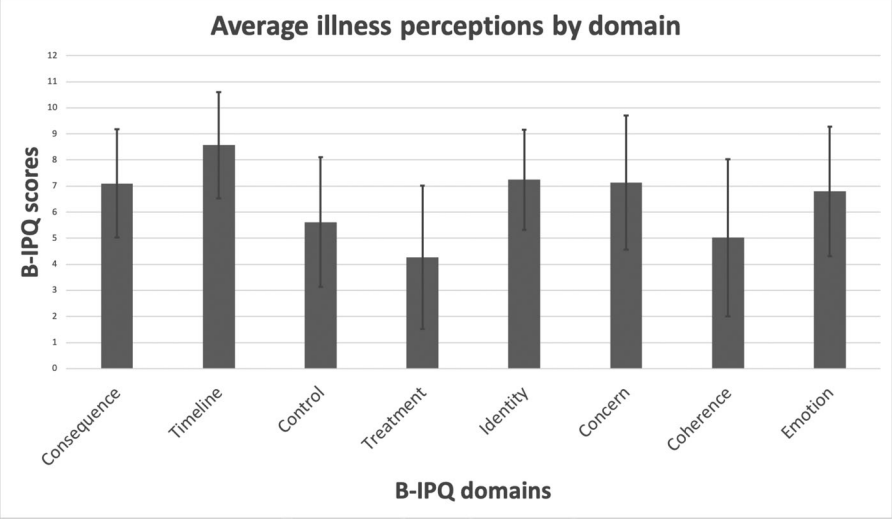

Figure 2. Mean and standard deviation of sample illness perceptions by domain.

Table 1. Illness perceptions: dysfunctional breathing (DB) only or comorbid with other respiratory conditions (MANOVA results).

Domain	Co-morbidity	Mean	SD
Consequences	Only DB	6.71	2.41
	Other lung	7.35	1.82
Timeline	Only DB	7.68	2.48
	Other lung	9.04	1.53
Personal Control	Only DB	5.71	2.71
	Other lung	5.65	2.41
Treatment Control	Only DB	3.74	2.41
	Other lung	4.52	2.93
Identity	Only DB	6.77	2.19
	Other lung	7.65	1.61
Coherence	Only DB	4.77	2.92
	Other lung	4.96	3.11
Emotional representation	Only DB	6.1	2.63
	Other lung	7.22	2.12
Concern	Only DB	6.55	2.47
	Other lung	7.5	2.36

***p<.001 **p<.05.
DB: dysfunctional breathing.

Table 2. Associations between illness perceptions, symptom severity, influence on daily living, depression and anxiety.

B-IPQ domain	Symptom severity (Nij) (Rho)	Depression (PHQ-9) (Rho)	Anxiety (GAD-7) (Rho)	Impact on daily living (IDL)(Rho)
Consequence	0.11	**0.45*** **	**0.31** **	**0.55*** **
Timeline	−0.02	**0.27** **	**0.24** **	0.20
Personal Control	0.11	0.19	**0.24** **	−0.03
Treatment Control	0.12	**0.27** **	**0.30** **	−0.00
Identity	0.02	**0.42*** **	**0.36** **	**0.50*** **
Concern	0.17	**0.30** **	**0.37*** **	**0.39*** **
Coherence	0.13	0.08	0.09	−0.14
Emotion	**0.23** **	**0.50*** **	**0.45*** **	**0.43*** **

***p<.001, **p<.05.
B-IPQ: Brief Illness Perceptions Questionnaire; GAD-7: Generalized Anxiety Disorder Questionnaire; IDL: Influence on Daily Living Questionnaire; Nij: Nijmegen Questionnaire; PHQ-9: Patient Health Questionnaire.

Table 3. Hierarchical multiple regression analysis 1: illness perceptions and depression.

	Model 1 (n=61)		Model 2 (n=61)		Model 3 (n=61)	
	β	p-value	β	p-value	β	p-value
Model 1						
Age	−0.06	.675	−0.03	.832	−0.09	.435
Gender	0.12	.418	0.14	.354	0.01	.970
Weight	0.23	.126	0.21	.167	0.19	.126
Model 2						
Illness severity			0.15	.278	0.06	.610
Model 3						
Consequence					−0.06	.740
Timeline					0.02	.889
Treatment					0.08	.492
Identity					0.35	.039
Concern					−0.18	.168
Emotion					0.52	<.001
R^2	0.04		0.06		0.46	
Adj. R^2			−0.002		0.35	
Extra sum of squares F	0.89		0.97		4.32	
p-value	.453		.432		<.001	

(r (82)=.23, p=.038), though linear regression analysis did not find a significant predictive relationship (F(1,80)=3.88, p>.05).

Illness perceptions and psychosocial outcomes (depression and anxiety)

Correlational analyses demonstrated significant associations between multiple illness perceptions and depression and anxiety.

All illness perceptions domains apart from personal control and coherence significantly positively correlated with depression scores, with emotion (ρ = 0.50, p<.001), consequence (ρ = 0.45, p<.001) and identity (ρ = 0.42, p<.001) respectively showing the strongest associations. Significant positive anxiety associations were found with all illness perception domains except for coherence. The strongest associations were between anxiety and emotion (ρ = 0.45, p<.001), followed by concern (ρ = 0.37, p=.001) and then identity (ρ = 0.36, p=.002). More intense emotional impact of the illness and perceiving more symptoms were associated with higher levels of depression and anxiety.

A hierarchical multiple regression was carried out to assess the impact of illness perception domains on depression (PHQ) after controlling for the influence of demographic factors (age, gender and weight) and symptom severity (NIJ) (Table 3). Demographic factors entered at step 1 did not significantly explain variance in depression scores (p>.05). Symptom severity, added at step 2, did not significantly explain variance in depression (p>.05). Illness perception domains of consequence, timeline, treatment, identity, concern and emotion (control and coherence did not meet assumptions for multicollinearity) added in step 3, explained 39.5% (R^2 change) of the variance in depression, adj. R^2=.352, F(10,51)=4.32, p<.001. In the final model, illness representations of emotion and identity made the biggest contributions to variance in depression scores (β = 0.52, p<.001 and β = 0.35, p=.039 respectively). Individuals who perceived a higher emotional impact of their illness and who had a strong illness identity had higher depression ratings.

A hierarchical multiple regression was carried out to assess the impact of illness perception domains on anxiety (GAD) after controlling for the influence of demographic factors (age, gender and weight) and symptom severity (NIJ) (Table 4). Demographic factors entered at step 1 did not significantly explain variance in anxiety scores (p>.05). Symptom severity, added at step 2, also did not significantly explain variance in anxiety (p>.05). Illness perception domains

Table 4. Hierarchical multiple regression analysis 2: illness perceptions and anxiety.

	Model 1 ($n=58$)		Model 2 ($n=58$)		Model 3 ($n=58$)	
	β	*p*-value	β	*p*-value	β	*p*-value
Model 1						
Age	0.06	.674	0.12	.361	0.11	.359
Gender	−0.03	.874	−0.01	.964	−0.24	.081
Weight	0.21	.178	.16	.292	0.05	.691
Model 2						
Illness severity			0.29	.034	0.16	.155
Model 3						
Consequence					−0.30	.102
Timeline					−0.02	.841
Treatment					0.02	.877
Control					0.26	.042
Identity					0.55	.001
Concern					−0.05	.685
Emotion					0.41	.006
R^2	0.05		0.13		0.52	
Adj. R^2			0.07		0.40	
Extra sum of squares F	1.05		2.02		4.55	
p-value	.378		.105		<.001	

Table 5. Hierarchical multiple regression analysis 3: illness perceptions and influence on daily living.

	Model 1 ($n=61$)		Model 2 ($n=61$)		Model 3 ($n=61$)	
	β	*p*-value	β	*p*-value	β	*p*-value
Model 1						
Age	−0.04	.775	−0.04	.794	−0.13	.275
Gender	0.30	.046	−0.30	.048	0.14	.294
Weight	0.22	.122	0.22	.136	0.15	.220
Model 2						
Illness severity			0.01	.922	−0.07	.546
Model 3						
Timeline					−0.06	.636
Identity					0.39	.008
Concern					0.11	.410
Emotion					0.27	.046
R^2	0.09		0.09		0.42	
Adj. R^2	0.04		0.02		0.33	
Extra sum of squares F	1.82		1.34		4.79	
p-value	.154		.922		<.001	

of consequence, timeline, treatment, control, identity, concern and emotion (coherence did not meet assumptions for multicollinearity) added in step 3, explained 38.6% (R^2 change) of the variance in anxiety, adj. R^2=.40, F(11,47)=4.55, p<.001. In the final model, illness representations of emotion and identity made the biggest contributions to variance in anxiety scores (β = 0.41, p=.006 and β = 0.55, p=.001 respectively). Individuals who perceived a higher emotional impact of their illness and who had a strong illness identity had higher anxiety ratings.

Illness perceptions and influence on daily living

Significant positive associations were found between the perceived impact of DB on daily living and illness perceptions of Consequence, Identity, Concern and Emotion, indicating that the more that patients perceived DB as impacting on daily living, the greater they perceived the illness as having a consequence on their life, with severe and frequent illness symptoms, greater emotional impact of their illness and were more concerned about it.

A hierarchical multiple regression was carried out to assess the impact of illness perception domains on influence on daily living (IDL) after controlling for the influence of demographic factors (age, gender and weight) and symptom severity (NIJ) (Table 5). Demographic factors entered at step 1 did not significantly explain variance in IDL scores (p>.05). Symptom severity, added at step 2, did not significantly explain variance in IDL (p>.05). Illness perception domains of timeline, identity, concern and emotion (other domains did not meet assumptions for multicollinearity) added in step 3, explained 33.3% (R^2 change) of the variance in IDL, adj. R^2=.33, F(8,53)=4.79, p<.001. In the final model, illness representations of emotion and identity made the biggest contributions to variance in IDL scores (β = 0.27, p=.046 and β = 0.39, p=.008 respectively). Individuals who perceived a higher emotional impact of their illness and who had a strong illness identity experienced greater influence on daily living from their illness.

Discussion

Our study demonstrates strong positive relationships between the illness perceptions that individuals with DB held and psychosocial outcomes. The emotional domain of illness beliefs had a weak but positive correlation with symptom severity as measured by the Nijmegen scale.

Individuals with DB believed the condition was chronic with severe symptoms, had a substantial consequence on their lives and it caused them great concern. Individuals also perceived poor condition control and limited condition knowledge. Coupled with these cognitive beliefs, the emotional reaction was also negative. These outcomes were regardless of length of time since diagnosis, whether individuals perceived that they had been diagnosed or not or whether individuals' symptom severity was above or below the DB diagnostic threshold.

There are several reasons why people with DB may hold such negative perceptions of their illness, including misdiagnosis, respiratory challenges, and ambiguity of illness. DB is frequently misdiagnosed (1–3) so a lack

of a coherent understanding of the condition is reasonable. Perceiving that the illness would bring adverse consequences is also understandable for those experiencing extreme respiratory challenges (35). Further, the etiological ambiguity of DB may precipitate negative emotional responses (25) similar to the frustration, isolation and uncertainly reported in studies of people who have medically unexplained symptoms (36).

Our results correspond with previous literature indicating that individuals with DB frequently experience multiple comorbidities (5). Eight participants had a single diagnosis of DB, while the majority had psychological (52%) or other physical (80%) health conditions or (46%) both. Those who had a comorbid respiratory condition had more negative illness perceptions on all domains though differences were not statistically significant. Illness perceptions of different conditions may aggregate resulting in more negative cognitions and more extreme emotional responses (37,38). The more negative illness perceptions held by those with comorbid health conditions may be the consequence of struggling to distinguish symptoms of ambiguous conditions (as is the case with both DB (7) and Long COVID (39). There is a risk that the confusion may lead to attribution of more symptoms to DB.

There was no significant difference in illness perception scores in our study between those who confirmed diagnosis and those who did not. For the 26% of our sample who were uncertain of their diagnosis, a schematic representation may be difficult to manifest though it is apparent both groups held similar perceptions.

Consistent with the CS-SRM, our results demonstrate that more negative perceptions were associated with poorer psychosocial outcomes (15). The stronger the belief individuals had that DB impacted on their lives, with more profound experience of symptoms, and greater concerns about the illness, the more severe their experiences of anxiety, depression and influence on daily living. The regression models indicated that the illness perception domains of emotion and identity were the strongest significant predictors of anxiety, depression and influence on daily living, even after controlling for symptom severity.

These results are consistent with studies of illness perceptions and psychosocial outcomes of other long-term conditions (40–42). In a study of illness perceptions and anxiety of people with congenital heart disease, illness perceptions explained more of the variance in anxiety than both sociodemographic variables and medical characteristics (42). Similarly, in a study of people with COPD, mood was associated with perceiving greater consequences of the illness, more severe symptoms and negative emotional representations (43).

It is important to note limitations of this study. With 82 participants, a *post hoc* power analysis conducted using G*Power version 3.1.9.7 (24) for medium effect size at significant criterion α=.05, has a power of .64, thus type 1 error is a risk. Another limitation is to do with the measures; given the comorbidity experienced by individuals, we cannot be certain that individuals were completing the IPQ with DB in mind despite instructions to do so. The questionnaires were self-report which relies on questionnaire comprehension and can increase the possibility of response bias.

Further, the study was cross-sectional, thus, direction of causality cannot be determined. Illness perceptions themselves may be inversely affected by mental health particularly since depression may distort cognitions (44); mental health may predict illness perceptions, rather the converse.

Although direction of causality cannot be determined, isolating the specific cognitive and emotional constructs that correlate with anxiety or depression as we have done here, may assist intervention development. For example, breathing retraining has been established as a component of both effective anxiety and DB treatments (31,42,45). Integrating techniques in an intervention directed toward improving both identity and emotional constructs may enhance breathing and psychosocial outcomes. Nonetheless, longitudinal research is needed to be more certain of the relationship direction.

Conclusions

Our study demonstrates that illness perceptions of DB correlate with psychosocial outcomes though not with symptom severity. Individuals who perceived their illness negatively had poorer psychosocial outcomes in a manner which is consistent with the CS-SRM. The CS-SRM contends that perceptions individuals hold of their illness may have robust relationships with outcomes; changing cognitions may change outcomes (8,12).

While further research is necessary, there is a compelling case to develop interventions to improve illness cognitions, in particular domains of emotion and identity, to strengthen breathing retraining while also mitigating the effects of anxiety, depression and impact on daily living.

Declaration of interest

The authors report there are no competing interests to declare.

Data availability statement

The data that support the findings of this study are openly available in DataSTORRE at http://hdl.handle.net/11667/236.

Funding

This work was supported by the Engineering and Physical Sciences Research Council under Grant Ref: EP/W003600/1.

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