Journal of Clinical Neuroscience 80 (2020) 56–62

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Clinical study

Cognitive behavioral therapy reduces illness perceptions and anxiety symptoms in patients with unruptured intracranial aneurysm

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ARTICLE INFO

Article history:
Received 19 March 2020
Accepted 30 July 2020

Keywords:
Cognitive behavioral therapy
Anxiety
Illness perceptions
Unruptured
Intracranial aneurysm
Structural models

ABSTRACT

The main purpose of this study was to assess the relation between cognitive behavioral therapy and possible changes in illness perceptions and anxiety in patients diagnosed with unruptured intracranial aneurysm. An observational study of an intervention with 67 patients with an unruptured intracranial aneurysm from two medical centers in a Colombian city (n = 35 on the intervention group) was carried out. To assess changes, measurements were taken at baseline and at one-year follow-up with the Beck Anxiety Inventory and the Illness Perception Questionnaire, brief version, taking into account the importance of perceptions in the process of adjusting to illness and acquiring healthy life habits. Hypotheses were tested by a structural model. The results obtained from this study showed that illness perceptions were related to anxiety levels at both time points; however, the relations were stronger before cognitive behavioral therapy ($\beta t0 = 0.61$, $p < 0.01$; $\beta t1 = 0.37$, $p < 0.01$). Cognitive behavioral therapy was found to be a moderator of changes in both illness perceptions and anxiety at the time of follow-up ($\beta = -0.31$, $p < 0.01$; $\beta = -0.26$, $p < 0.01$). The structural model suggests that cognitive behavioral therapy is associated with less anxiety ($\beta = -0.17$, $p < 0.05$) and better illness perceptions ($\beta = -0.35$, $p < 0.01$) in patients diagnosed with unruptured intracranial aneurysms.

1. Introduction

The prevalence of unruptured intracranial aneurysms (UIAs) is approximately 2% [1,2], with a mortality rate of 32% to 67% in the case of rupture [3]. The usual treatment is coiling or clipping; however, with a risk of rupture <1%, the risk of aneurysm rupture must be balanced with the risk of treatment-related adverse outcomes [4]. In some cases, considering the age and sex of the patient, aneurysm location, morphology and underlying systemic diseases, the patient and doctor choose to follow-up and not treat the aneurysm [5–7].

The diagnoses of a UIA can trigger high levels of anxiety due the perception of a life-threatening condition [3,8–10]. Studies have shown that patients with untreated UIAs have significant levels of anxiety [1,11]. Additionally, previous reports have shown that compared with meningioma patients, a higher proportion of patients who received UIA intervention had a psychiatric medical history before the intervention [12]. These aspects have led authors to recognize the importance of psychological accompaniment with this population [13].

Cognitive behavioral therapy (CBT) has shown good effects for decreasing anxiety in people with anxiety disorders [14] and those with comorbid health problems, such as heart disease [15], inflammatory bowel disease [16] and hemorrhoids [17]. However, psychological intervention reports in people with UIA are scarce.

On the other hand, the common-sense model proposes that illness perceptions are associated with the adjustments a patient makes to a health condition. Studies have shown that among individuals with medical conditions who perceive their disease as chronic, emotional impact and control over the disease due to treatment are positively associated with healthcare use, thereby enhancing the use of prescription medication and doctor recommended supplements [18]. Additionally, in patients with coronary artery disease, a better understanding of the illness enables personal control and increases quality of life [19]. In contrast, patients

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https://doi.org/10.1016/j.jocn.2020.07.071
0967-5868/

diagnosed with type II diabetes mellitus who do not perceive their illness as serious because of the absence of symptoms fail to make or postpone making recommended lifestyle changes until complications related to the disease appear [20]. Similarly, illness perceptions have been associated with emotional symptoms in chronic disease patients. The perceptions of symptom burden and personal control are associated with anxiety and depression in cardiac failure patients [21].

CBT could be used to reduce not only emotional symptoms but also illness perceptions in chronic disease patients. One study with 28 patients with rheumatoid arthritis showed differences in disease perception and depression, anxiety, and stress symptoms pre- and postintervention using Mindfulness CBT [22]. Similarly, a study with 69 patients with multiple chemical sensitivity found that CBT had a significant effect on illness perceptions, and this effect was sustained at 12-month follow-up. This study did not find significant results with regard to emotional symptoms [23]. Additionally, illness perception could influence the effect of CBT. One study with functional somatic syndrome patients showed that improvements in illness perceptions during treatment partially mediated the effect of CBT on physical health one year after treatment [24].

These previous results lead us to hypothesize that CBT could be a good intervention for emotional symptoms in patients with UIA, especially considering possible misconceptions about UIA, for example, the risk of rupture. Thus, this study aimed to evaluate the impact of CBT on anxiety symptoms in UIA patients and examine whether changes in illness perceptions affect the level of anxiety symptoms in these patients.

2. Method

2.1. Type of study

This observational intervention study focused on diminishing anxiety symptoms and illness perceptions in patients with UIA, keeping in mind the importance of perceptions in the process of adjusting to illness and acquiring healthy life habits.

2.2. Population and sample

The population was a sample of patients enrolled in an n ongoing longitudinal follow-up study in patients with UIAs (N = 90) from two medical centers in Medellín, Colombia (South America). The patients chose, after a judicious analysis with their neurosurgeon, not to undergo aneurysm intervention but rather to be assigned to a watchful waiting protocol. The baseline sample was analyzed in a previous paper [25].

The patients were recruited between June 2016 and March 2019; eight could not be reached, eleven refused to participate, and four decided to undergo surgery. In the end, 67 patients (74.4% of the original sample) were evaluated. The participants were allocated into two groups, control and intervention, considering the preferences of the patients. However, when the intervention group was completed (35 participants, 52.2% of the sample), the remaining participants were allocated to the control group (32 participants, 47.8% of the sample). During the intervention, three participants in the intervention group quit because of a lack of time for the sessions. Follow-up was performed one year after each patient's last visit to the center. During this time, 25 participants in the control group and 29 participants in the intervention group were evaluated; thus the retention rates were 78.1% and 90.6%, respectively. The flow diagram shows the samples sizes during each phase (Fig. 1).

2.3. Measures

Anxiety was assessed by the Beck Anxiety Inventory, Spanish adaptation (BAI) [26]. This self-completed questionnaire is used to determine anxious symptoms and their gravity in adults and adolescents. The original validation had high internal consistency (α = 0.92); furthermore, the retest reliability of the subscales after one week had a 0.75 correlation. The reported correlations for concurrent and discriminant validity with different anxiety and depression questionnaires were as follows: 0.51 with Hamilton's Anxiety Scale, 0.48 with Beck's Depression Inventory, and 0.47 and 0.58, respectively, with the state and trait anxiety subscales of the State Trait Anxiety Inventory – STAI [27]. The Spanish validation also showed adequate internal consistency, between 0.85 and 0.93 [28]. In this study, Cronbach's alpha was 0.814.

Illness Perception were assessed by the Illness Perception Questionnaire, brief version, Spanish version (BIPQ) [29]. This questionnaire developed by Broadbent, Petrie, Main y Weinman (2006) has eight items and an additional open question about the causes of the disease. It is based on the common-sense model, which evaluates illness perceptions in chronically ill patients, including the way people evaluate the consequences and duration of a disease and their understanding of the disease, their perceived control and the influence of treatment on the disease and their emotions related to the pathology. The validation of the questionnaire showed significant high to moderate correlations with the scales of the Revised Illness Perception Questionnaire (IPQ-R). Reliability was measured with the retest test after three and six weeks, and the lower correlations were r = 0.48 (coherence scale) at three weeks and r = 0.42 (personal control) at six weeks [30].

2.4. Procedure

The patients were invited to participate during their appointments with the neurosurgeon. Those who agreed received a call to schedule another appointment to be informed about the purpose of the study, sign an informed consent form and complete the evaluation protocol. The patients assigned to the intervention group were contacted by the therapist the same week to schedule an appointment and start psychotherapy.

An individualized intervention was carried out with goals set at the first session. To achieve this, the therapist reviewed psychological test results and interviewed the patient regarding problems affecting their stress levels and mood. An important factor considered for goal setting within therapy was the diagnosis of the aneurism. The psychotherapy protocol had 16 appointments. If a patient reported feeling good for two appointments in a row, the therapist asked the patient if he/she wanted to work on a specific task or if he/she preferred to stop the intervention process. The mean number of sessions was 9 (D.T. = 6.62), and the range was between 2 and 16 sessions. A follow-up of both groups was completed one year after the first assessment. This study met all legal requirements for human research and was approved by the Ethics Committee at Universidad EAFIT.

2.5. Analysis

The hypotheses of this study were as follows: (H1a) illness perceptions positively affects anxiety in UIA patients, (H1b) the influence of illness perceptions on anxiety decreases after CBT; (H2) CBT affects illness perceptions; and (H3) CBT affects anxiety levels.

To test whether CBT had effects on the influence of illness perceptions on anxiety (H1a and H1b) and on each of these constructs across time, the authors specified a model with the effects of illness perceptions on anxiety at the two time points and carry-on effects for both constructs. These are effects of one construct on itself at a

subsequent time point [31]. Related to the two carry-on effects, two interaction terms were specified to test H2 and H3. For the former, an interaction between IPQ at baseline and CBT was added to the model. To test the last hypothesis of the study, the researchers summed the interaction between BAI at time point 0 and CBT. Given the complexity of the model, the latent nature of the variables, and the relatively small sample size (n = 68), partial least squares structural equation modeling (PLS-SEM) was selected to analyze the data [32]. In contrast to analyses such as ANCOVA or repeated measures ANOVA where composite variables are used to test the hypotheses, leading to several limitations [33], SEM allows the testing of the psychometric properties of the scales. The authors used the Smart PLS (v. 3.2.7) [34] statistical package to this end. In this type of analysis, a minimum sample size of 65 observations is calculated for a power of 80%, a significance level of 0.05, a maximum of four arrows (see effects on anxiety t1) pointing at a construct, and a minimum R^2 of 0.25.

In PLS-SEM, the first step consists of evaluating the measurement model. Researchers should also assess the specified structural model [32]. Regarding the measurement model, the validity and reliability of the scales selected to measure the latent variable should be evaluated. Convergent validity is assessed using the average extracted variance (AVE) coefficients and the factor loadings. AVE values above 0.50 and factor loadings over 0.70 are acceptable. Factor loadings below that value may be retained if they contribute to construct reliability. Reliability is evaluated using two coefficients: Cronbach's Alpha (α) and Composite Reliability (CR), with a critical value >0.70.

The second step in the PLS-SEM approach involves the assessment of the structural model. The structural model is assessed by examining the coefficients of determination (R^2), predictive relevance (Q^2), and effect sizes (f^2) [35]. R^2 values or explained variances of 0.25, 0.50, and 0.75 can be interpreted as weak, medium, and substantial, respectively. f^2 scores of 0.02, 0.15, and 0.35 indicate small, medium, and large contributions, respectively, to the target construct. Regarding Q^2, the model has predictive relevance for each of the endogenous constructs if the score is higher than zero.

Variance inflated factor (VIF) coefficients of all latent variables in the model were examined as indicators of common method bias (CMB). VIF scores above 3.3 suggest that the model is affected by CMB [36].

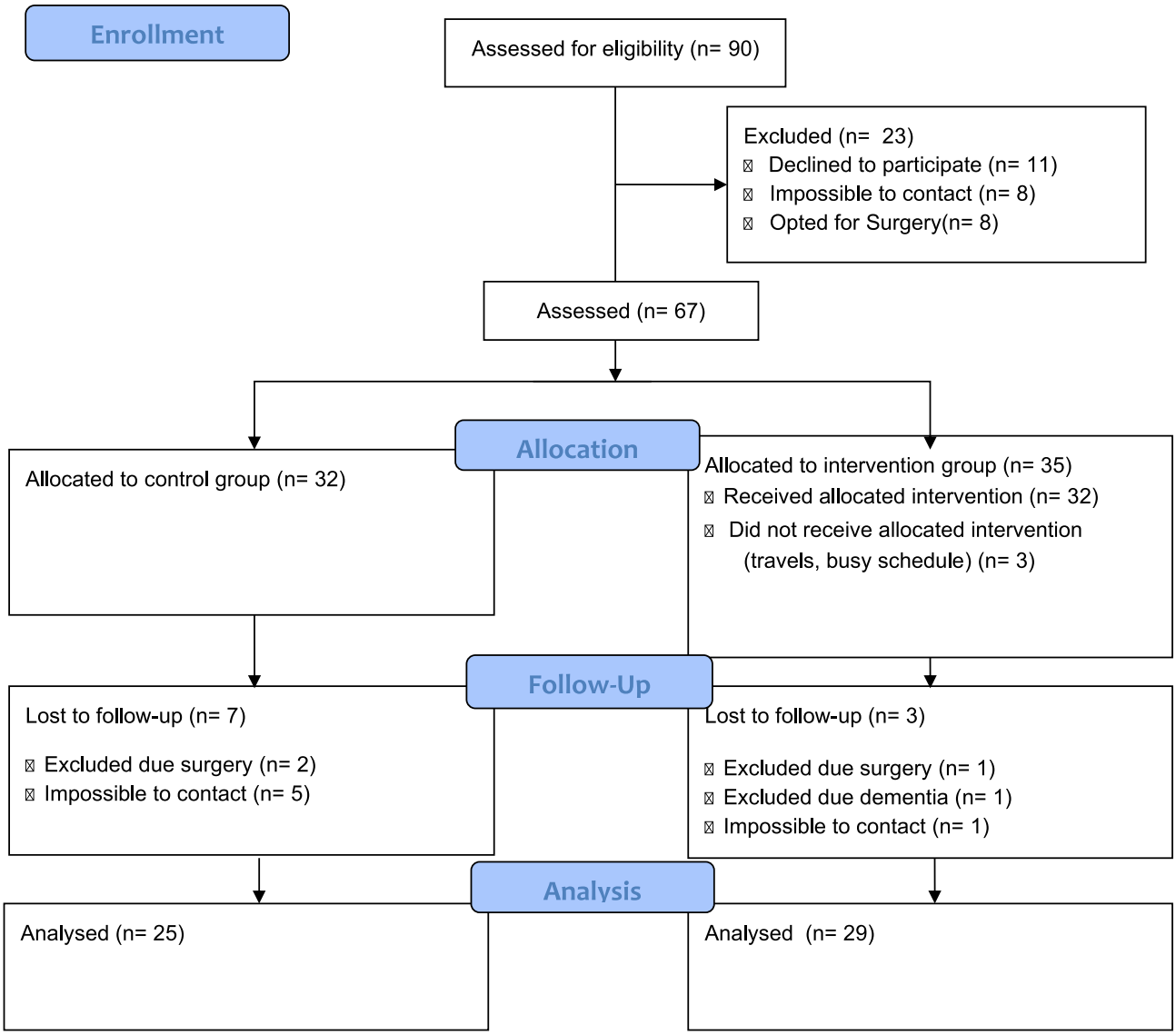

Fig. 1. Flow diagram of the study sample.

3. Results

3.1. Demographic characteristics

The initial sample included 90 people, 67 (74.4%) of whom agreed to participate. Of the participants, 35 (52.2%) initiated psychological intervention, and 32 (47.8%) were in the control group. The study sample was 85.1% female, 43.3% were married, and about half of the sample (47.8%) belonged to a middle socioeconomic class. The mean age of the participants was 62.5 years (S. D = 11.77). No statistically significant differences among cases and control characteristics were detected ($p > 0.05$). The participant demographics are described in Table 1.

All included patients presented aneurysms with some common characteristics that were part of the analysis regarding the best treatment plan. The aneurysms were mostly small (<7 mm in diameter), almost all were saccular, and a few had irregularities in the dome, specifically a bleb. In all cases, the decision to opt for watchful waiting arose from the patient, who, in the company of his/her family and after hearing the explanation of the neurosurgeon, concluded that he/she felt the risk of the intervention was greater than the natural history of the lesion. None of the patients decided to forego intervention because their neurosurgeon considered the lesion extremely difficult to access or intractable whether by surgical or endovascular means.

Table 1
Descriptive statistic of the sample.

	Intervention group (n = 35)	Control group (n = 32)	Total sample
	n (%)/M (S.D.)	n (%)/M (S.D.)	n (%)/M (S.D.)
Age	64.34 (10.2)	60.56 (13.2)	62.54 (11.77)
Sex			
Women	30 (85.7)	27 (84.4)	57 (85.1)
Men	5 (14.3)	5 (15.6)	10 (14.9)
Civil status			
Married	16 (45.7)	13 (40.6)	29 (43.3)
Separated	7 (20.0)	2 (6.3)	9 (13.4)
Widow/er	7 (20.0)	8 (25.0)	15 (22.4)
Single	5 (14.3)	9 (28.1)	14 (20.9)
Socio-economical position			
Low	5 (14.3)	7 (21.9)	12 (17.9)
Middle	17 (48.6)	15 (46.9)	32 (47.8)
High	11 (34.3)	10 (31.3)	22 (32.8)
No answer	1 (2.9)		1 (1.5)
Time from diagnosis (months)	31.4 (36.1)	53.47 (56.9)	41.94 (48.1)

3.2. Anxiety and illness perceptions

Regarding anxiety, 28.4% of the participants reported moderate and severe anxiety levels, while 23.9% reported low levels of anxiety. At the follow-up, only 11.9% of the participants reported clinically significant anxiety levels (Table 2). No differences were detected between anxiety scores for the intervention (M = 10.80, S.D. = 9.48) and control (M = 12.97, S.D. = 11.45) groups, $p > 0.05$.

Regarding illness perceptions, the results showed that the participants perceived their condition (presence of aneurisms) as a low-consequence condition in their life and as a chronic condition that does not identify them, that makes them worry and generates a low emotional response. The patients also reported that they believed their disease can be controlled through medical treatment and that they understood their disease. The scores regarding personal control were, on average, moderate to high. The intervention and control groups showed differences in understanding of the illness T (32.4) = 2.370, $p < 0.05$ and were higher in the intervention group. Other perceptions did not show any significant differences (Table 3).

3.3. Structural model

The results of the PLS-SEM measurement model show that after eliminating several items, the scales had good psychometric properties (i.e., validity and reliability; Table 4). The items were eliminated after taking into account two criteria: high collinearity scores (VIFs) and/or factor loadings below the cut-off value. As shown in Fig. 2, some items with low factor loadings were retained,

Table 2
Pre – post prevalence rates of anxiety in the sample.

Variable	Baseline		One year follow up	
	Intervention group n (%)	Control group n (%)	Intervention group n (%)	Control group n (%)
Absence	18 (51.4)	14 (43.8)	23 (79.3)	12 (48.0)
Mild	8 (22.9)	8 (25.0)	5 (17.2)	6 (24.0)
Moderate	4 (11.4)	6 (18.8)	1 (3.4)	3 (12.0)
Severe	5 (14.3)	4 (12.5)	0 (0)	4 (16.0)

Table 3
Pre – post measures of Illness perception in the sample.

Variable	Baseline		One year follow up	
	Intervention group M (S.D.)	Control group M (S.D.)	Intervention group M (S.D.)	Control group M (S.D.)
Consequences	3.40 (3.07)	3.41 (3.70)	1.48 (1.88)	3.56 (3.43)
Temporality	8.00 (3.16)	8.00 (3.58)	9.17 (2.00)	8.00 (3.08)
Identity	1.79 (2.62)	2.84 (3.49)	1.21 (2.41)	3.12 (3.32)
Concern	3.57 (3.25)	4.48 (4.15)	1.72 (2.25)	3.92 (3.90)
Emotional response	3.77 (3.31)	3.19 (3.71)	1.41 (1.94)	3.96 (3.70)
Personal control	6.34 (3.60)	6.69 (4.01)	8.48 (2.73)	5.72 (4.00)
Treatment control	7.82 (3.50)	6.78 (4.17)	8.69 (2.28)	5.56 (4.36)
Coherence	8.80 (2.35)	6.94 (3.72)	9.10 (1.70)	7.92 (2.96)
Total score	27.63 (10.94)	31.25 (16.00)	18.72 (7.73)	33.36 (17.29)

Table 4
Construct Reliability and Validity.

				HTMT		
	α	CR	AVE	1	2	3
1. IP t0	0.74	0.92	0.58			
2. IP t1	0.88	0.84	0.74	0.68		
3. Anx t0	0.89	0.91	0.57	0.72	0.54	
4. Anx t1	0.89	0.91	0.58	0.46	0.75	0.66

as their deletion did not lead to increased construct reliability and because they did not show collinearity issues.

Regarding the structural model, the results supported the hypotheses of the study. The regression standardized coefficients are represented in Fig. 2. Specifically, the effect of illness perceptions on anxiety was positive and significant at both time points, but the effect at time point 1 was stronger (H1a and H1b). Regarding H2 and H3, both the effect of the moderator (CBT) and the interactions (i.e., CBT* illness perceptions t0 and CBT* anxiety t0) were negative and significant. As mentioned above and displayed in Fig. 2, CBT was coded as CBT treatment = 1 and Not CBT treatment = 0. Hence, the results show that the absence of CBT negatively affects the development of both illness perceptions and anxiety.

The other results support the structural model containing the study hypotheses (Table 5). The variances explained by the model (R^2) ranged from small to medium, and the contribution of each path to the corresponding R^2 were equally classified.

Further, Q^2 values were not 0 for all endogenous constructs (IP t1 = 0.35; Anx t0 = 0.17; Anx t1 = 0.31), suggesting that the model has predictive relevance for all the endogenous constructs. Finally, with a maximum value of 1.69, the VIFs of all latent variables were below the rule of thumb, suggesting an absence of CMB.

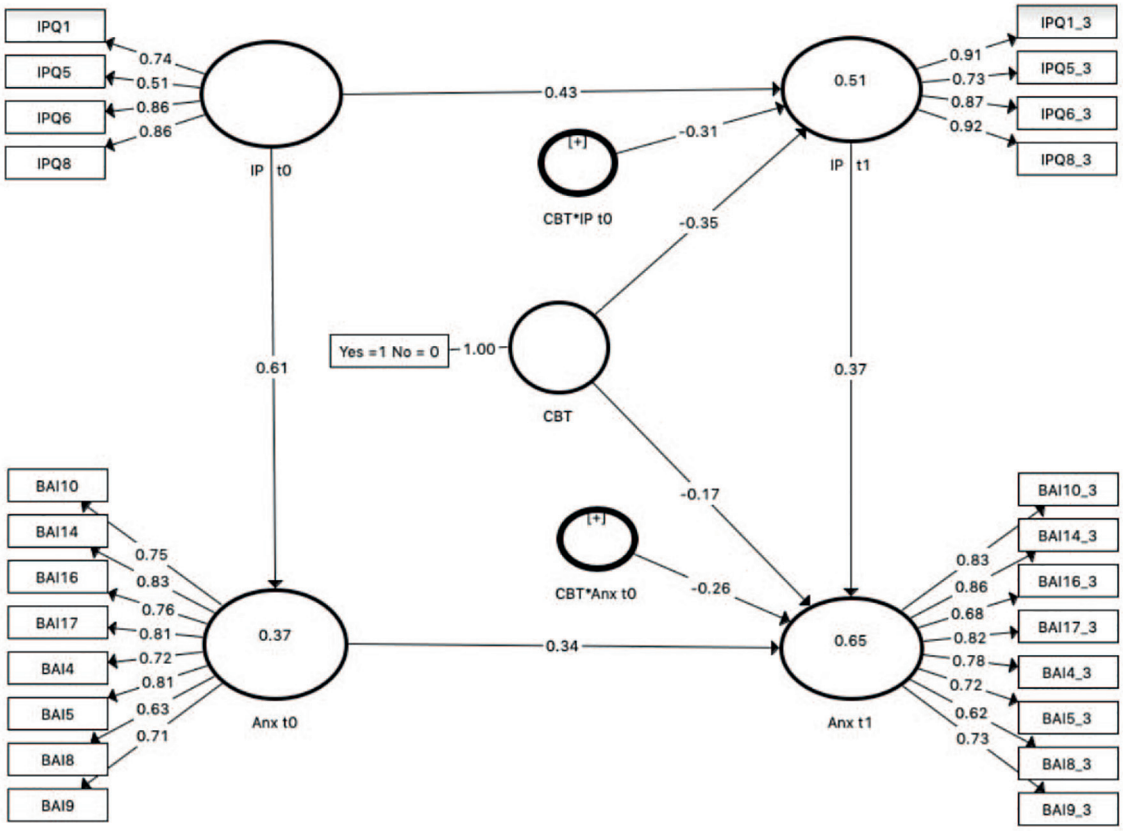

Fig. 2. PLS-Structural model. *Note:* The bootstrapping procedure with 1000 samples provided p values and 95% confidence intervals for the parameters. All factor loadings were significant ($p < 0.01$). All the structural paths were significant ($p < 0.01$), except for CBT -> Anx t1 ($p < 0.05$). The absence of zero within the corresponding 95% CIs supported the significance of the regression coefficients.

Table 5
Coefficients of Determinacy and Effect Sizes.

Dependent variable	R^2	Effect size (f^2) of variable					
		IP t0	IP t1	Anx t0	CBT	CBT*IP	CBT*Anx
1. IP t1	0.51**	0.34**			0.24**	0.17**	
2. Anx t0	0.37*	0.59***					
3. Anx t1	0.65**		0.23**	0.25**	0.07*		0.16**

Note: Classification of determinacy and effect size coefficients; weak/small*, medium**, substantial/large***.

4. Discussion

This study aimed to assess the impact of CBT on illness perceptions and anxiety symptoms in UIA patients and examine whether illness perceptions affect anxiety symptoms levels in these patients. The results confirmed our hypotheses, as illness perceptions were found to be related to anxiety in patients with UIA, and CBT influenced reduced illness perceptions and anxiety levels in this population.

Our results showed that CBT reduces not only anxiety symptoms [14] but also illness perceptions in patients with UIA, and these results are similar to those observed for other health conditions [22,37]. The results could be explained considering that the therapy process in this population included exposure, Socratic questioning and cognitive restructuration regarding anxious symptoms [38] as well as challenging illness perceptions about UIA.

The intervention helped patients perceive UIA as having fewer negative consequences in their lives and that symptoms are not related to the aneurysm, and it encouraged them to be less concerned for their condition and to have fewer emotions in response to it. These perceptions support other studies that have shown that the impact of a UIA is less than that of other conditions and that most patients die from natural causes unrelated to the aneurism [39].

Our structural model revealed that the effect of CBT on anxiety is not direct but is associated with the perception of the health condition. These results showed the importance of psychoeducation when a psychological intervention is performed in patients with chronic illness, as previously reported. Better perceptions about their condition implies less anxiety levels in patients with UIA.

Illness perceptions have been related with health behaviors in other studies [19–20]. Prior studies led us to hypothesize that changes in illness perception might be related with better health behaviors in patients with UIA. Other studies in myocardial patients have reported that an intervention focused on disease misconceptions improved perceptions but also the likelihood of exercising [40] and returning to work earlier [41]. Similar results were found in patients with functional somatic syndromes, where illness perceptions partially mediated the effect of CBT on physical health [24].

This study has some limitations that are worth noting. First, the sample was small, meaning that the final model could not include more variables that would have been interesting to analyze. Second, the sample could not be randomized; thus, biases due to the patients' preferences regarding intervention are possible.

In conclusion, this study found that illness perceptions are related to anxiety symptoms in patients with UIA and that CBT can reduce both factors. These results could be used as a base for psychological interventions targeted to this population to improve their health-related quality of life.

Funding

This work was supported by the Departamento Administrativo de Ciencia, Tecnología e Innovación – COLCIENCIAS [Project code: 121674455404 – Call number 744 de 2016] and Universidad EAFIT – Colombia.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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