The Influence of Asthma Control on Psychosocial Outcomes for Pregnant Women with Asthma

Abstract

Objective. To investigate the relationship between asthma control and psychosocial outcomes in pregnant women with asthma. *Methods.* Secondary analysis (N=221) of a randomized controlled trial of treatment adjustments, based on fractional exhaled nitric oxide versus clinical guideline-based algorithms. Psychosocial variables included generic and asthma-specific quality of life (SF12, AQLQ-M), illness perceptions (BIPQ), perceived control (PCAQ), perceived risk of side effects (PRSE) and anxiety (STAI-6). Asthma control was defined as controlled (Asthma Control Questionnaire (ACQ7) ≤ 1.5 at randomization and end of study), improved (ACQ7 > 1.5 at randomization and ≤ 1.5 at end of study) and unimproved (ACQ7 > 1.5 at end of study). Regression models were fitted for each psychosocial measure at the end of the study, with adjustment for baseline values and smoking status, with predictor variable asthma control. *Results.* Women with unimproved asthma had poorer physical (SF12, p=0.012) and asthma-specific quality of life across all domains (AQLQ-M, p≤0.012) compared to women with controlled asthma. They believed that they had less control over their asthma (PCAQ total p=0.014), had more symptoms and that their illness had a greater effect on their emotions and their lives in general (BIPQ identity, consequences, concern, emotional response p≤0.015). Women with improved asthma control had significantly lower AQLQ-M breathlessness (p=0.048) and lower total scores (p=0.04) than women with controlled asthma. *Conclusions*. Pregnant women who are not able to get control of their asthma symptoms may experience worse quality of life and are likely to have more negative perceptions about their condition.

Keywords: Quality of life, illness beliefs, perception, anxiety, pregnancy, asthma.

Introduction

Asthma is a common chronic disease worldwide and affects 8–12% of pregnancies [1–4]. The impact of asthma on pregnant women is particularly important since it has implications both for the mother and the developing fetus [5–7]. More than one third of pregnancies in women with asthma are complicated by loss of asthma control and by exacerbations of asthma, which may be associated with poor perinatal outcomes [5]. Pregnancy complicated by asthma has been shown to increase the risk of preeclampsia, the fetus being small for gestational age and preterm birth [6], as well as low birth weight [5,6].

Research in non-pregnant populations has shown that poorer asthma control is associated with worse asthma-specific and generic quality of life [8–11] and anxiety [12,13]. Poorer asthma control in adults at baseline, as assessed by the Asthma Therapy Assessment Questionnaire (ATAQ), has predicted worse asthma-specific and generic quality of life (Mini-Asthma Quality of Life Questionnaire and EuroQoL 5D) 12 months later [8]. In this study the change in asthma control from baseline to 12 months was also a significant predictor of asthma-specific but not generic quality of life [8]. Uncontrolled asthma was associated with poorer asthma-specific quality of life (Asthma Quality of Life Questionnaire (AQLQ) and Medical Outcomes Survey 36 Item Short Form survey (SF-36)), using the 2006 – 2009 Global Initiative for Asthma (GINA) guidelines to assess asthma control in adults [9].

A stronger association between asthma control and asthma-specific quality of life measures (AQLQ - Marks) than with generic quality of life measures (SF-36) was reported in a study using five separate measures of asthma control on people aged 16 to 75 [10]. Another study, also using ATAQ, found that poorer asthma control in adults was associated with worse

asthma-specific and generic quality of life (AQLQ-S and SF-36) [11]. Two studies, using the Asthma Control Test (ACT), reported that poorly controlled asthma in adults was associated with higher anxiety, as measured on the Hospital Anxiety and Depression Scale (HADS) [12,13]. However, little is known about how asthma control and changes in control over time impacts the psychosocial wellbeing, cognitions and beliefs of pregnant women, who are known to be at an increased risk of adverse perinatal outcomes [7]. To our knowledge there are currently no published analyses of the effect of changes in asthma control over time on psychosocial wellbeing during pregnancy.

The Managing Asthma in Pregnancy (MAP) study was the first randomized study of fractional exhaled nitric oxide (FENO) based management of asthma in pregnant women [14]. Secondary analyses from this study have shown that lower emotional response scores were related to uncontrolled asthma [15] and that women's perceptions of asthma control and their anxiety, assessed at baseline, were associated with future exacerbation risk, caesarean section and preterm birth, but there was no association with asthma control [7]. The aim of this paper is to investigate the effect of changes in asthma control on psychosocial outcomes throughout the pregnancy.

Methods

Participants

Pregnant women with asthma were recruited from two antenatal clinics (John Hunter Hospital and Maitland Hospital, NSW, Australia) into a double-blind, parallel, randomized controlled trial of FENO versus clinical guideline-based treatment adjustment. Eligible participants were between 12 and 20 weeks gestation and had used inhaled therapy for

asthma within the past year. The women were monitored for the remainder of their pregnancy at monthly antenatal clinic visits. Details of this study have been published elsewhere [14]. Women who were current smokers and followed the same protocol and randomization procedure as the MAP study were also included. The MAP study was approved by the Hunter New England Health and University of Newcastle Human Research Ethics Committees and is registered with the Australian and New Zealand Clinical Trials Registry (Number: 12607000561482).

Design

At randomization, asthma control was assessed using the asthma control questionnaire (ACQ7) [16] and psychosocial questionnaires measuring quality of life, illness and asthma control perception, anxiety and side effects perception were also administered. The smoking status of all participants was confirmed by urinary cotinine measurement (nicalert: NYMOX Corp., St-Laurent, Quebec, Canada) and exhaled carbon monoxide. Participants with urinary cotinine measurement less than 5 and exhaled carbon monoxide less than 10 ppm were confirmed as non-smokers. The primary analysis of these data was concerned with the comparison of the two treatment algorithms [14], while pre-specified secondary analyses include the investigation of the factors associated with uncontrolled asthma and treatment adherence [15]; factors associated with asthma exacerbation risk and perinatal outcomes [7]; and the analysis presented here, investigating whether women with controlled asthma have better psychosocial outcomes at the end of the study.

Asthma control questionnaire (ACQ7). The ACQ7 is the average of 7 questions on a 7-point scale [16] ranging from 0 (totally controlled) to 6 (severely uncontrolled). For 6 of these questions the participant indicates the severity of asthma symptoms (night time waking, symptoms on waking, activity limitation, shortness of breath, wheezing) and amount of short-

acting bronchodilator on a 7-point scale (0 = no impairment, 6 = maximum impairment). For the final question, clinical staff measure the % predicted forced expiratory volume in one second (FEV_1%) on a 7-point scale.

Psychosocial questionnaires. Quality of life was measured using the Medical Outcomes Study 12-Item Short-Form Health Survey version 1 (SF-12v1) [17] and the Asthma Quality of Life Questionnaire-Marks (AQLQ-M) [18]. The SF-12v1 is the short form of a generic survey which assesses functional health and well-being. The mental component summary (MCS) and physical component summary (PCS) each have scores ranging from 0 to 100 with higher scores indicating better health (a score of 50 represents US normal values) [17]. The AQLQ-M is a 20-item asthma-specific survey across four domains: breathlessness, concerns for health, mood disturbance and social disruption. The total AQLQ-M score and the domain scores range from 0 to 10 with a higher score reflecting poorer asthma-specific quality of life [18].

The Brief Illness Perception Questionnaire (Brief IPQ) assesses cognitive and emotional representations of asthma as well as the level of understanding of asthma over eight items, including consequences (no effect to severe), timeline (short to long), personal control (none to extreme), treatment control (not helpful to very helpful), identity (no symptoms to severe symptoms), concern (none to extreme), understanding (none to clear) and emotional response (none to extreme) [19]. These items are assessed on a linear scale from 0 to 10.

The Perceived Control of Asthma Questionnaire (PCAQ) was used to measure the participants' perceived control of asthma symptoms and asthma management [20]. This questionnaire has 11 items each graded on a 1–5 point Likert scale. The possible PCAQ total score ranges from 11 to 55 with higher scores indicating better perceived control of asthma. The Perceived Risk of Side Effects (PRSE) questionnaire is a visual analogue scale ranging

from 0% (no side effects) to 100% (severe deformity) to assess the amount of risk the participant believes the medication would have on the fetus [21]. The PRSE questionnaire was used for each of the medications: ventolin (salbutamol), inhaled corticosteroids, and prednisolone, then the mean of these three scores was used as a summary of the perceived risk of side effects of medication for each participant. The Six-Item Short-Form State Trait Anxiety Inventory (STAI-6), based on a 1-4 point Likert scale for each question, was used to measure anxiety [22]. Scores range from 20 to 80 with higher scores indicating high anxiety.

Statistical Analysis

Regression models were fitted for each of the psychosocial measures at the end of the study (visit 5) with adjustment for values at randomization (visit 2) and smoking status, with predictor variable asthma control. Asthma control (ACQ) was classified as a 3-level categorical variable using the ACQ7 score: controlled (ACQ7 <=1.5 for visits 2 and 5), improved (ACQ7 > 1.5 at visit 2 and <= 1.5 at visit 5) and unimproved (ACQ7 > 1.5 at visits 2 and visit 5, or ACQ7 <= 1.5 at visit 2 and > 1.5 at visit 5). Controlled asthma was the reference category for this variable. We used the likelihood ratio test to test for the overall effect of asthma control and Wald tests for the three comparisons of ACQ categories (controlled versus improved, controlled versus unimproved, and improved versus unimproved). Since the two treatment algorithms being compared in the primary analysis were based on asthma control and were, therefore, considered to be on the causal pathway, we did not include treatment group in the regression models. There were minimal missing data and women who did have missing data were excluded from the analysis for that particular outcome. We took the approach that as many women as possible should contribute to each analysis rather than restricting the analysis to complete cases only. A comparison of

the baseline demographics of the women with complete data (183) and women with missing data showed that there were no statistically significant differences between these two groups of women for any of the baseline demographics or health measures ($p \geq 0.109$). Multiple imputation was not conducted as there were no other variables that could be used to impute the missing data.

All psychosocial measures were treated as continuous outcomes. Assumptions of normality and constant variance were checked and natural log transformations were used where appropriate. All AQLQ-M outcomes, BIPQ outcomes consequences, concern and emotional response, and PRSE mean were log transformed, with the corresponding results being reported as percentages. For the SF12 mental summary outcome there was evidence of heteroscedasticity and in the absence of a variance-stabilising transformation that allowed easy interpretation of the estimates, robust standard errors of type HC3 were used [23]. For BIPQ outcomes personal control, treatment control and understanding, there was evidence of departures from normality in the diagnostic plots. A power transformation of each of these outcomes remedied this non-normality but since the results were similar for the transformed and untransformed outcomes, in the interests of ease of interpretation the results presented here are for the untransformed outcomes. The assumption of normality is less important in samples of this size [24]. Analysis was performed using STATA 12 (StataCorp, College Station, TX, USA).

Results

Data from the psychosocial questionnaires at randomization and at the end of the study were available for 221 pregnant women. At randomization participants' mean (SD) age was 28.3

(5.4) years, 38 (17.2%) were smokers and the mean FEV_1% predicted was 95.8 (13.5) (Table 1). The mean gestational age was 19.7 (2.0) weeks at randomization and 32.6 (2.6) at the end of the study and the mean of the asthma control average score at randomization was 0.9 (0.7). We grouped women based on their asthma control at randomization and at the end of the study and 72.9% of the women had controlled asthma, 15.4% had asthma that improved and 11.8% had asthma that did not improve over the course of the study (Table 2).

The psychosocial questionnaire scores at randomization are presented in Table 3. The median AQLQ-M domain scores and the total score were all low (≤ 1.5) and the median SF-12v1 mental summary score was higher than the US population norm, indicating a perception of good quality of life. The illness perception scores suggest that women believed that asthma had little effect on their lives, (median consequences score = 2/10), had minimal effect on their emotions (emotional response score = 1/10), was a long-term illness (timeline score = 8/10), and caused mild symptoms and some concern (identity and concern scores = 3/10). Women also believed that they had a high amount of control over their asthma (personal control score = 8/10), that the treatment was substantially helpful (treatment control score = 9/10) and that they had a very good understanding of their illness (understanding score = 8/10). Women believed that they had moderate to good ability to deal with asthma and its exacerbations (median PCAQ score = 43/55), had low anxiety (median STAI-6 score = 26.7/80) and that the risk of side effects from asthma medications was low (median PRSE mean score = 12%).

Quality of life outcomes (AQLQ-M and SF12)

At the end of the study, women with unimproved asthma control had the poorest asthma-specific quality of life scores across all domains. This group had breathlessness scores 2.37

(95% CI: [1.81, 3.11], p < 0.001) times that of women with controlled asthma, or alternatively, higher breathlessness domain scores by 137% (95% CI: [81%, 211%], p < 0.001) (Table 4). Women with unimproved asthma had higher concerns domain scores by 64% (95% CI: [35%, 100%], p < 0.001), higher mood domain scores by 37% (95% CI: [7%, 76%], p = 0.012), higher social domain scores by 92% (95% CI: [53%, 139%], p < 0.001) and higher total AQLQ-M scores by 69% (95% CI: [41%, 103%], p < 0.001), compared to women with controlled asthma (Table 4). Women with improved asthma control had lower breathlessness domain scores by 23% (95% CI: [0%, 41%], p = 0.048), and lower total AQLQ-M scores by 16% (95% CI: [1%, 29%], p = 0.040), compared to women with controlled asthma (Table 4), possibly because they perceived a change and improvement in their asthma control. For each domain, additional comparisons between women with unimproved asthma and women with improved asthma (not presented in Table 4) showed that for all AQLQ-M domain scores except mood, women with unimproved asthma control had worse scores than women with improved asthma control (p < 0.001).

Women with unimproved asthma control had lower SF12 physical component summary scores, indicating poorer generic physical quality of life, compared to both women with controlled asthma (estimated mean difference: MD = -4.12 (95% CI: [-7.33, -0.90], p = 0.012) (Table 4) and improved asthma control (p = 0.031).

Brief Illness Perception Questionnaire (BIPQ)

Women with unimproved asthma control had higher consequences scores by 74% (95% CI: [31%, 133%], p < 0.001), higher identity scores (MD = 1.75, 95% CI: [0.99, 2.52], p < 0.001), higher concern scores by 54% (95% CI: [11%, 114%], p = 0.010) and higher emotional response scores by 50% (95% CI: [8%, 108%], p = 0.015), compared to women

with controlled asthma (Table 4). This indicates that these women believed that they had more symptoms associated with their asthma, that their asthma had a greater effect on their lives, that they had greater concern about their asthma and that there were greater emotional effects. Women with unimproved asthma control also had higher scores for consequences, identity, concern and emotional response outcomes than women with improved asthma control ($p \leq 0.005$).

Perceived Control of Asthma Questionnaire (PCAQ)

Women with unimproved asthma control had lower PCAQ total scores, indicating that they had poorer perceived control of their asthma, compared with women with controlled asthma (MD = -2.56, 95% CI: [-4.60, -0.51], $p = 0.014$) (Table 4), and women with improved asthma control ($p = 0.004$).

Perceived Risk of Side Effects (PRSE)

There was no evidence of an association between PRSE scores and asthma control (Table 4).

Anxiety (STAI-6)

There was no difference in scores for varying levels of asthma control (Table 4).

Discussion

This is the first study to investigate the effect of changes in asthma control over time on psychosocial outcomes in pregnant women with asthma and provides evidence to inform pregnant women about the physical and psychological effects they are likely to experience if they are able to gain better control of their asthma during their pregnancy and the likely

impact on their asthma symptoms and wellbeing if they are not. Women with unimproved asthma had worse scores for 11 of the psychosocial outcomes, compared to women with controlled asthma. However, there was no difference in scores between women with controlled and improved asthma for all but two of the outcomes and this lack of difference was not unexpected since asthma was controlled for both these groups by the end of the study.

Women with unimproved asthma control had poorer generic physical quality of life and asthma-specific quality of life across all domains, compared to women with controlled asthma. This group also had poorer asthma-specific quality of life across all domains except mood, than women with improved asthma control. Women with improved asthma control had better overall asthma-specific quality of life and better quality of life in the breathlessness domain. We found no association between generic mental quality of life and asthma control. These results are consistent with previous studies which found that poorer asthma control is associated with worse asthma-specific and generic quality of life in non-pregnant people [8–9]. However, our results are not consistent with two studies reporting that poorer mental quality of life was related to worse asthma control [10,11]. This is most likely to be due to differences in recruitment strategies between the studies. In the first study [10], participants were recruited via both population sampling and emergency departments. They were older than our sample of pregnant women (16 – 75 years old, mean age: 44.8) and, for many, the asthma was likely to be more severe (15% had had a hospital admission or ED presentation for asthma in the previous 6 months). In the second study [11], 64% of the participants were more than 45 years old and 21% of the younger participants (18 – 45 years old) reported chronic bronchitis, emphysema or COPD.

Women with unimproved asthma control also believed that they had less control over their asthma, their asthma was more severe and that their illness had a greater effect on their emotions and their lives in general, compared with women with controlled asthma and with women with improved asthma control. We found no association between anxiety and asthma control, which is consistent with the results of one study [25] but not with the results of two other studies [12,13]. The participants for these two studies were recruited from asthma clinics and, therefore, may be expected to have more symptomology, both in asthma symptoms and psychological distress.

In the MAP Study the participants were randomized to treatment adjustments based on fractional exhaled nitric oxide versus clinical guideline–based algorithms. It is not possible to randomize participants to different asthma control groups as opposed to treatment groups, so this secondary analysis of asthma control is the best possible design for investigating asthma control and psychosocial outcomes in pregnant women. Because data was from a well-designed RCT there is minimal missing data and maximal follow-up. The asthma control questionnaire (ACQ7) used in this study combines perceptions from the women on their asthma as well as an assessment of FEV_1% by the clinic staff. Subjective measures of asthma control may miss important differences in the disease but this is minimized by including the objective FEV_1% measure.

The generalizability of these results is limited for a number of reasons. The participants in the MAP study were restricted to pregnant women with a doctor's diagnosis of asthma, who had been taking regular inhaled asthma therapy in the past three months or had current asthma symptoms. Participants predominantly had mild asthma with women excluded if they had concomitant chronic medical illness such as chronic lung disease other than asthma, if they had three or more courses of oral corticosteroids in the past year or a hospital admission for

an asthma exacerbation in the last three months, or if they were regularly using oral prednisolone or theophylline. Participants in the study were more frequently monitored with free monthly clinic visits and fortnightly phone calls, rather than clinic visits only two to three times during pregnancy. This resulted in a reduction in hospital admission for exacerbation and a greater percentage of women being assessed by a physician at exacerbation [26]. Therefore participants in this study were more likely to have controlled asthma which remained under control throughout the pregnancy, than women not participating in the study. We also did not have a sample size large enough to separate those whose control declined (n = 18), i.e. had controlled asthma at visit 2 and uncontrolled asthma at visit 5, from those whose asthma was uncontrolled at both visits (n = 8). Further investigation of women in this situation would be valuable.

Conclusion

Poor asthma control which does not improve during pregnancy is associated with worse physical quality of life and asthma-specific quality of life, and negative illness perceptions, compared with women who maintain or improve asthma control during pregnancy. This study provides further evidence of the potential beneficial psychosocial effects of improving asthma control for pregnant women.

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Table 1. Demographics and health measures at randomization.

	N	Mean (SD)	Median (IQR)
Age	221	28.3 (5.4)	28.4 (24.7, 31.7)
Gestational age (weeks)	220	19.7 (2.0)	20 (19, 21)
BMI (kg/m^2)	219	29.2 (6.9)	28.3 (24.1, 32.4)
FEV_1% predicted	219	95.8 (13.5)	95.8 (87.6, 104.2)
FVC% predicted	219	104.8 (14.1)	103.5 (95.3, 113.1)
Asthma control average score (ACQ7)	221	0.9 (0.7)	0.9 (0.4, 1.3)
Smoker n (%)	221	38 (17.2%)	

Table 2. Asthma control classification.

Category	Asthma control (ACQ7)		n (%)
	At randomization (visit 2)	At end of study (visit 5)	(N=221)
Controlled	<= 1.5	<= 1.5	161 (72.9%)
Improved	> 1.5	<= 1.5	34 (15.4%)
Unimproved	Any value	> 1.5	26 (11.8%)

Table 3. Psychosocial questionnaires at randomization.

Questionnaire	Domain	Possible score Range	N	Mean (SD)	Median (IQR)
Asthma Quality of Life – Marks (AQLQ-M) [18]	Breathlessness	0 – 10	219	1.6 (1.5)	1.5 (0.5, 2.5)
(good – poor)	Concerns	0 – 10	219	0.6 (0.9)	0.4 (0, 0.7)
	Mood	0 – 10	220	2.0 (1.6)	1.5 (1, 3)
	Social	0 – 10	219	0.6 (1.0)	0 (0, 0.7)
	Total	0 – 10	218	1.2 (1.1)	0.9 (0.5, 1.6)
12-Item Short-Form Health Survey (SF-12v1) [17]	Mental component summary	0 – 100	221	51.3 (9.1)	55.0 (46.7, 57.9)
(below – above US norm (50))	Physical component summary	0 – 100	221	47.3 (8.1)	49.3 (42.6, 53.2)
Brief Illness Perception (BIPQ) [19]	Consequences	0 – 10	218	2.4 (1.9)	2 (1, 3)
(none/not at all - extreme/very clearly)	Timeline	0 – 10	218	7.2 (3.0)	8 (5, 10)
	Personal control	0 – 10	220	7.4 (2.4)	8 (5.5, 9)
	Treatment control	0 – 10	220	8.7 (1.7)	9 (8, 10)
	Identity	0 – 10	220	3.4 (2.0)	3 (2, 5)
	Concern	0 – 10	220	3.0 (2.4)	3 (1, 4.5)
	Understanding	0 – 10	220	7.2 (2.2)	8 (5, 9)
	Emotional response	0 – 10	220	1.7 (2.2)	1 (0, 3)
Perceived Control of Asthma (PCAQ) [20] (poor – good)	Total	11 – 55	217	43.3 (5.0)	43 (40, 47)
Perceived Risk of Side Effects (PRSE) [21] (low risk – high risk)	Mean	0 – 100%	209	16.4 (16.1)	12 (3, 25)
6-Item Short-Form State Trait Anxiety Inventory (STAI-6) [22] (low – high anxiety)	Total	20 - 80	213	29.4 (10.2)	26.7 (20.0, 36.7)

Table 4. Regression results[a] .

	Outcome	Predictor	Categories	Estimate[b] (95% CI)	Likelihood ratio p-value
AQLQ-M	Breathlessness (log transformed) N=219	Asthma control	Controlled (ref.)	1	< 0.001
			Improved	0.77 (0.59, 1.00)*	
			Unimproved	2.37 (1.81, 3.11)***	
	Concerns (log transformed) N=218	Asthma control	Controlled (ref.)	1	< 0.001
			Improved	0.89 (0.74, 1.05)	
			Unimproved	1.64 (1.35, 2.00)***	
	Mood (log transformed) N=219	Asthma control	Controlled (ref.)	1	0.039
			Improved	1.08 (0.87, 1.35)	
			Unimproved	1.37 (1.07, 1.76)*	
	Social (log transformed) N=216	Asthma control	Controlled (ref.)	1	< 0.001
			Improved	0.91 (0.75, 1.11)	
			Unimproved	1.92 (1.53, 2.39)***	
	Total (log transformed) N=208	Asthma control	Controlled (ref.)	1	< 0.001
			Improved	0.84 (0.71, 0.99)*	
			Unimproved	1.69 (1.41, 2.03)***	
SF12	Mental component summary N=220	Asthma control	Controlled (ref.)	0	0.481
			Improved	0.89 (-1.54, 3.31)	
			Unimproved	-1.53 (-5.04, 1.98)	
	Physical component summary N=220	Asthma control	Controlled (ref.)	0	0.034
			Improved	0.13 (-2.73, 2.98)	
			Unimproved	-4.12 (-7.33, -0.90)*	

BIPQ	Consequences (log transformed) N=216	Asthma control	Controlled (ref.) Improved Unimproved	1 1.02 (0.80, 1.29) 1.74 (1.31, 2.33)***	< 0.001
	Timeline N=214	Asthma control	Controlled (ref.) Improved Unimproved	0 -0.69 (-1.47, 0.09) 0.31 (-0.61, 1.23)	0.137
	Personal control N=218	Asthma control	Controlled (ref.) Improved Unimproved	0 -0.52 (-1.32, 0.28) -1.01 (-1.94, -0.08)*	0.065
	Treatment control N=218	Asthma control	Controlled (ref.) Improved Unimproved	0 -0.27 (-0.96, 0.43) -0.28 (-1.09, 0.53)	0.629
	Identity N=218	Asthma control	Controlled (ref.) Improved Unimproved	0 0.19 (-0.46, 0.84) 1.75 (0.99, 2.52)***	< 0.001
	Concern (log transformed) N=218	Asthma control	Controlled (ref.) Improved Unimproved	1 0.88 (0.67, 1.17) 1.54 (1.11, 2.14)**	0.013
	Understanding N=218	Asthma control	Controlled (ref.) Improved Unimproved	0 -0.88 (-1.66, -0.11)* -0.24 (-1.14, 0.67)	0.078
	Emotional response (log transformed) N=218	Asthma control	Controlled (ref.) Improved Unimproved	1 0.83 (0.63, 1.08) 1.50 (1.08, 2.08)*	0.009

PCAQ	Total N=215	Asthma control	Controlled (ref.) Improved Unimproved	0 1.02 (-0.72, 2.76) -2.56 (-4.60, -0.51)*	0.012
PRSE	Mean (log transformed) N=207	Asthma control	Controlled (ref.) Improved Unimproved	1 0.92 (0.59, 1.46) 1.12 (0.67, 1.89)	0.827
STAI-6	Total (log transformed) N=210	Asthma control	Controlled (ref.) Improved Unimproved	1 0.90 (0.80, 1.00) 0.97 (0.85, 1.10)	0.154

[a] Regression: outcome at end of study, adjusted for baseline (randomization) value and smoking status.
[b] Estimate = mean difference (if outcome not transformed); geometric mean ratio (if outcome log transformed).
* $0.01 < p < 0.05$; ** $0.001 < p < 0.01$; *** $p < 0.001$.