

PREGNANCY

Psychosocial Outcomes Are Related to Asthma Control and Quality of Life in Pregnant Women with Asthma

HEATHER POWELL, M.MED.SC.,¹ KIRSTEN MCCAFFERY, B.SC., PH.D.,²
VANESSA E. MURPHY, B.MED.CHEM., PH.D.,³ MICHAEL J. HENSLEY, FAFPHM, PH.D., FRACP, M.B.B.S.,^{1,3}
VICKI L. CLIFTON, B.SC., PH.D.,⁴ WARWICK GILES, PH.D., FRANZCOG, M.B.B.S.,^{2,5} AND
PETER G. GIBSON, M.B.B.S., FRACP^{1,3,*}

¹Department of Respiratory & Sleep Medicine, Hunter Medical Research Institute, John Hunter Hospital, Newcastle, NSW, Australia.

²School of Medicine and Public Health, Faculty of Medicine, University of Newcastle, Newcastle, Australia.

³School of Public Health, University of Sydney, Sydney NSW, Australia.

⁴School of Paediatrics and Reproductive Health, University of Adelaide, SA, Australia.

⁵School of Obstetrics, Gynaecology and Neonatology, University of Sydney and Royal North Shore Hospital, Sydney, NSW, Australia.

Background. Little is known about the psychosocial impact and perceived teratogenic (fetal harm due to medication) risks of asthma treatment (inhaled/oral corticosteroids and β -agonist) during pregnancy. **Aims.** To assess the perception of asthma control, quality of life (QoL), and perceived risks of therapy in pregnant women with asthma. **Methods.** Pregnant women with asthma ($n = 125$) were recruited between 12 and 20 weeks gestation. QoL (generic: Short Form-12 Health Survey v1, and asthma specific: Asthma Quality of Life Questionnaire-Marks (AQLQ-M)) and psychological variables were assessed using the Perceived Control of Asthma Questionnaire (PCAQ), the Brief Illness Perception Questionnaire, and the Six-Item Short-Form State Trait Anxiety Inventory (STAI-6). Women's perceptions of the teratogenic risks of asthma therapy were also assessed and analyzed for adherence to maintenance inhaled corticosteroids (ICSs), poor asthma control, and QoL. **Results.** Women reported good QoL (median AQLQ-M total score/maximum score = 0.88/10), moderate ability to deal with asthma symptoms (mean PCAQ score = 42.6/55), positive beliefs about their asthma and low anxiety (median STAI score = 26.7/80). Perceived teratogenic risks for asthma drugs were excessive and class dependent. Women perceived there was a 42% teratogenic risk for oral corticosteroid, a 12% risk for ICSs, and a 5% risk with short-acting β -agonist. Illness beliefs, emotional response to illness ($p = .030$), age ≥ 30 years ($p = .046$), and maintenance ICS use ($p = .045$) were significantly associated with uncontrolled asthma, while maintenance ICS use ($p = .023$), illness beliefs, consequences ($p = .044$), timeline ($p = .016$), and emotional response ($p = .015$) and anxiety ($p \leq .0001$) were significantly associated with reduced QoL. **Conclusions.** In pregnancy, women with asthma experience good QoL but overestimate teratogenic risks of asthma medication. Maintenance ICS use, illness beliefs, and anxiety are associated with impaired QoL and asthma control.

Keywords asthma control, illness beliefs, perception, quality of life, teratogenic risk

INTRODUCTION

Asthma is one of most prevalent chronic medical conditions to complicate pregnancy (1, 2), and both asthma severity and asthma exacerbations have been associated with adverse perinatal outcomes. International guidelines recommend prevention of asthma exacerbations and active management of asthma during pregnancy in order to optimize the health of both the mother and fetus (3). Psychosocial variables such as illness perception and anxiety are known to influence asthma control, future risk of asthma exacerbation, and adherence to therapy in nonpregnant patients with asthma (4, 5). In addition, while inhaled corticosteroid (ICS) therapy can effectively treat asthma in pregnancy, many women and their doctors express concern regarding ICS use in pregnancy. Consequently, fear of ICS side effects leads to

under-dosing (6) and limited adherence to treatment (7) and results in unnecessary morbidity from asthma (8).

Little is known about the psychosocial impact of having asthma and attitudes to its treatment during pregnancy. The mother's perceptions about the teratogenic risk (risk of fetal harm) of asthma medications are also poorly described. These are important issues that might influence clinical outcomes and treatment adherence during pregnancy. Therefore, the aim of this article was to describe psychosocial aspects of asthma during pregnancy and examine their association with disease control. We specifically examined the perception of medication risk, perceived ability to deal with asthma symptoms and exacerbations (perceived self-efficacy), illness beliefs, anxiety, and health-related quality of life (QoL) in pregnant women with asthma during the early stages of the pregnancy.

METHODS

Participants

Pregnant women with asthma were recruited from the John Hunter Hospital antenatal clinic when they presented

*Corresponding author: Peter G. Gibson, M.B.B.S., FRACP, Level 3 HMRI, John Hunter Hospital Locked Bag 1 Hunter Region Mail Centre, Newcastle, NSW 2310, Australia. Tel: +61 2 49855766; Fax: +61 2 49855850; E-mail: peter.gibson@hnehealth.nsw.gov.au

for routine antenatal care prior to 20 weeks gestation. The women were given information regarding the study by the midwife or research nurse, and consenting participants were included if they were between 12 and 20 weeks gestation, were >18 years of age, had a doctor's diagnosis of asthma, and had been taking regular inhaled asthma therapy in the past 3 months or had current asthma symptoms. Exclusion criteria were the presence of a concomitant chronic medical illness (e.g., chronic lung disease other than asthma), drug or alcohol dependence, inability to attend study visits, inability to perform spirometry or fractional exhaled nitric oxide measurement (FENO), three or more courses of oral corticosteroids (OCSs) in the past year, a hospital admission for an asthma exacerbation in the past 3 months, patients using regular oral prednisolone or theophylline, and unstable diabetes.

Clinical Measures

Design. We report baseline data from a randomized controlled trial in pregnant women with asthma of treatment adjustment according to guidelines (control group) or an algorithm based on forced exhaled nitric oxide level (FENO group). Full details of the trial are published elsewhere (9). The substudy is a cross-sectional survey of demographic, health, and psychosocial characteristics of pregnant women with asthma. Participants attended two baseline study visits a month apart prior to 22 weeks gestation. At the first visit, sociodemographic and asthma-related variables were collected by a clinical research nurse, asthma control was assessed using the asthma control questionnaire (ACQ) (10), and clinical asthma pattern was assessed using Global Initiative for Asthma (GINA) criteria (3). Spirometry and fractional exhaled nitric oxide (FENO) measurements were also performed. Atopy was defined as specific IgE to aeroallergen >0.35 ku in venous blood. At the second visit, the ACQ, FENO, and spirometry were repeated and self-administered psychosocial questionnaires were completed (Table 1). Women were classified as a current smoker based upon self-report or a urinary cotinine measurement ≥ 5 (Nicalert: NYMOX Corp. St-Laurent, QC, Canada) or exhaled carbon monoxide ≥ 10 ppm. Written informed consent was obtained from all participants in this study, which was approved by the Hunter New England Health Service and University of Newcastle Research Ethics Committees.

Psychosocial Measures

QoL was assessed using the MOS 12-Item Short-Form Health Survey version 1 (SF-12v1) (11) and the Asthma Quality of Life Questionnaire-Marks (AQLQ-M) (12). The SF-12v1 is a generic health status questionnaire that has been widely used for many diseases including asthma. A higher score equates to better health and a score of 50 equates to US normal values. The AQLQ-M is an asthma-specific QoL questionnaire that measures 20 items across four domains: breathlessness, mood, social, and concerns. Each domain and the total score range from 0 to 10 with a higher score reflecting poorer QoL.

TABLE 1.—Baseline demographics and health measures.

Demographics	N = 125
Age, mean (SD)	28.3 (5.7)
Smoker, n (%)	24 (19.4)
Gestational age, mean (SD) (weeks)	16.4 (2.4)
Education > 12 years, n (%)	70 (60)
Employed, n (%)	70 (60)
BMI ≥ 30 , n (%)	40 (42.5)
Australian born, n (%)	108 (92.3)
Health outcomes	
ACQ score, mean (SD)	0.9 (0.7)
ACQ > 1.5, n (%)	24 (19.2)
ICS, n (%)	66 (52.8)
80% adherence to ICS, n (%)	52 (80.0)
BDP equiv ICS daily dose (μ g)	770 (451)
FEV ₁ % predicted, mean (SD)	93.9 (13.4)
Asthma duration, mean (SD) (years)	19 (8)
GINA classification, n (%)	
Controlled	38 (30.4)
Partly controlled	53 (42.4)
Uncontrolled	34 (27.2)
FENO ppb, median (1,3Q)	14.9 (8.3, 28.9)
Atopy, n (%)	30 (27)

Note: ACQ, asthma control questionnaire; ICS, inhaled corticosteroid; BDP, beclomethasone dipropionate daily dose, mean (SD); BMI, pregnancy body mass index.

Perceived ability to deal with asthma symptoms and exacerbations was measured using the Perceived Control of Asthma Questionnaire (PCAQ) (13). The PCAQ is an 11-item questionnaire that measures individuals' perceptions of their asthma. Each response is graded on a 1–5 point Likert scale with a possible total score ranging from 11 to 55. A higher score indicates better perceived control of asthma.

The Brief Illness Perception Questionnaire (Brief IPQ) was used to assess cognitive and emotional representations of asthma (illness beliefs), including perceptions of consequence, timeline, personal control, treatment control, identity, concern, understanding, emotional response, and cause (14). It is a nine-item scale, which has been validated for use in several medical conditions, including asthma. Eight items are assessed on a continuous linear scale from 0 to 10 with an open-ended causal question (Appendix 1). The word "illness" was replaced with "asthma" for this study. Anxiety was assessed using the Six-Item Short-Form State Trait Anxiety Inventory (STAI-6) (15).

A measure of teratogenic risk of common medicines was used to assess women's perceptions of risk of harm from asthma medication to the fetus (16). This measure has been used to assess perception of risk of medication in pregnancy among clinicians and patients and has been tested among a sample of 281 participants including 81 pregnant women. The measure uses a visual analogue scale anchored from 0% (no side effects) to 100% (severe deformity to the developing fetus) (16). The measure was modified to include asthma medication. Participants were first asked if they were familiar with each of the medications: ventolin (salbutamol), ICSs, and prednisolone. Positive responders marked the visual

analogue scales to indicate their perception of risk of harm to the fetus during pregnancy (Appendix 2).

We compared the visual analogue scale against open-ended questions about the perception of teratogenic risk among 19 pregnant women with asthma to verify the measure in our asthmatic sample. Women were asked to describe in words how much risk they believed the medication would have on the baby before completing the visual analogue scale. The women's responses were consistent with their visual analogue scale (VAS) score: 0–10% equated to qualitative descriptors of “no risk/none”; 10–40% equated to “slight/some risk”; and >40% “quite a risk”/ “possible severe side effects.”

Statistical Analysis

Analysis was conducted using STATA 11 (StataCorp, College Station, TX, USA). Logistic regression was performed for factors associated with adherence to maintenance ICS (< or ≥80% self-reported adherence) and uncontrolled asthma. Asthma control was classified by ACQ score (≤ or >1.5) (17). Linear regression was performed for factors associated with QoL using the AQLQ-M total score (log transformed). Predictor variables included the psychosocial questionnaires, demographic characteristics, and perceived teratogenic risk. Any predictor variable with $p < .25$ on simple regression was included in a multiple regression and then stepwise removal of variables to achieve the highest R^2 value.

A p -value of <.05 was considered statistically significant. Predictor variables were tested for collinearity using STATA's variance inflation factors (VIF) postestimation.

RESULTS

Demographic and Clinical Characteristics

The women participating in the study ($n = 125$) had a mean (SD) age of 28.3 (5.7) years, a gestational age of 16.4 (2.4) weeks, and an asthma duration of 19 (8) years. Nineteen percent were smokers and 60% had more than 12 years' education (Table 1). Atopy was present in 27% of women, and 43% had a pregnancy BMI ≥ 30. FENO, median (1, 3Q), was 14.9 (8.3, 28.9) ppb. The majority of the women had mild asthma with a mean (SD) forced expiratory volume in one second (FEV₁) of 94% (14) predicted and ACQ score 0.9 (0.7). According to GINA classification (18), 30.4% were controlled, 42.4% were partly controlled, and 27.2% had uncontrolled asthma. Sixty percent were on maintenance ICS with a mean (SD) daily dose of 770 (451) µg.

Psychosocial Questionnaires

Pregnant women with asthma reported good QoL with median AQLQ-M total score of 0.88 out of 10 and domain scores ≤1.5 out of 10 and SF12v1 mental summary greater than the population norm, with a median score of

TABLE 2.—Psychosocial questionnaires.

Questionnaire [Citation]	Questionnaire title	Score range	Score range interpretation	Questionnaire domains	Questionnaire scores
Quality of life					$N = 125$
SF-12v1 (11)	Short Form (SF)-12 Health Survey	0–100	Below–above US norms (50)	PCS (physical summary) MCS (mental summary)	49.0 (43.2, 53.6) 55.0 (46.6, 57.9)
AQLQ-M (12)	Asthma Quality of Life Questionnaire-Marks	0–10	Good–poor	Total score Domain: breathlessness Mood Social Concerns	0.88 (0.5, 1.6) 1.0 (0.5, 2.5) 1.5 (1.0, 3.0) 0 (0, 0.7) 0.36 (0, 0.8)
Illness perception					
Brief IPQ (14)	Brief Illness Perception Questionnaire	0–10	None/not at all–extreme/very clearly	Consequences Timeline Personal control Treatment control Identity Concern Understanding Emotional response	2 (1, 3) 8 (5, 10) 8 (5, 9) 9 (7.5, 10) 3 (2, 5) 3 (1, 4) 8 (5, 9) 1 (0, 2.5)
Perceived self-efficacy					
PCAQ (20)	Perceived Control of Asthma Questionnaire	11–55	Poor–good	Total score ^a	42.6 (5.1)
Anxiety					
STAI-6 (15)	Six-Item Short-Form State Trait Anxiety Inventory	20–80	Low–high	Total score	26.7 (20.0, 36.7)
Perceived risk of side effects					
PRSE (16)	Perceived risk of side effects visual analogue scale	0–100%	Low risk–high risk	Salbutamol, $N = 115$ ICS, $N = 103$ Prednisolone, $N = 55$	5 (1, 12) 12 (3, 25) 42 (16, 70)

Note: Results are median (1, 3Q).

^aMean (SD).

55.0 (Table 2). Their perceived ability to deal with asthma symptoms and exacerbations was moderate to good (mean PCAQ score = 42.6) and they had low anxiety (median STAI-6 = 26.7).

The women's illness perception scores are shown in Table 2. The women held beliefs that asthma was a long-term illness, but the consequences were not too serious. They believed they had good control over their asthma and found treatment to be very helpful. The symptoms experienced from asthma (Brief IPQ: Identity) were perceived as mild and causing some concern; however, they felt they had a good understanding of asthma and perceived asthma to have a minimal emotional affect.

Perceived Teratogenic Risk of Medication Side Effects

The women perceived a lower risk of teratogenic effects for salbutamol (5%) and ICS (12%) use during pregnancy, than for prednisolone use (42%, $p < .001$ vs. salbutamol, $p < .001$ vs. ICS), Figure 1 and Table 2.

Factors Associated with Uncontrolled Asthma

Uncontrolled asthma as defined by ACQ > 1.5 was present in 19% of women. Asthma control was related to women's emotional response (OR [95% CI]: 0.62 [0.41, 0.96], $p = .030$) as measured by the Brief IPQ, age > 30 years (5.07 [1.03, 24.88], $p = .046$), and maintenance ICS use (6.30 [1.04, 37.96], $p = .045$) (Table 3). For each unit decrease in the Likert scale of the BIPQ emotions scale (less affected emotionally by their asthma), women were 38% less likely to have uncontrolled asthma.

Factors Associated with Adherence

Of the 65 women on maintenance ICS, 13 (20%) were less than 80% adherent according to self-report (Table 4). Simple logistic regression identified the presence of atopy, perceived timeline for asthma as longer (illness perception), and decreased anxiety (STAI-6 total score) as significantly associated with adherence, but after adjustment for other variables this significance was not maintained.

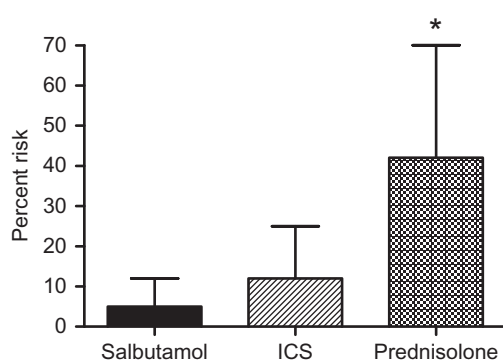


FIGURE 1.—Perceived risk of side effects on baby for salbutamol, inhaled corticosteroids (ICS), and prednisolone. Data are mean (SD); *post hoc test $p < .0001$ vs. ICS and salbutamol.

Factors Associated with QoL

Maintenance ICS use ($p = .032$), higher anxiety scores (STAI-6 total score) ($p < .0001$) and illness perception, consequences (perceived as more severe) ($p = .044$), timeline (perceived as longer) ($p = .016$), and emotional response (perceived as greater) ($p = .015$) were significantly associated with factors associated with poorer QoL (AQLQ-M) in a multiple linear regression (Table 5), whereas a higher FENO level was associated with a better QoL ($p = .028$).

DISCUSSION

This study demonstrates that this cohort of pregnant women with mild asthma experienced good QoL and in general held positive beliefs about their asthma. However, the perception of the risk of asthma medication on their unborn baby was overestimated compared to the actual risk, particularly in the case of oral corticosteroids. Maintenance ICS use was associated with higher levels of perceived asthma control and poorer QoL. Women's beliefs about the emotional effects of asthma (being less emotional) were associated with higher levels of perceived asthma control. Higher anxiety and more negative beliefs about the consequences, the timeline of their illness, and emotional response to asthma were associated with reduced QoL. These results demonstrate that there are associations between asthma outcomes and psychological status and beliefs in women during pregnancy.

A recent study reported a significant relationship between asthma-specific QoL in early pregnancy and the future risk of asthma exacerbations, independent of initial symptoms and lung function (19). Interestingly, better QoL in the emotional domain had a strong protective association with fewer asthma exacerbations during pregnancy (19). This link between better emotional function and reduced future risk of asthma exacerbation during pregnancy is important and underscores the need to further examine the relationship between psychological function and asthma in pregnancy, which was addressed in this study.

Perceived Control

We assessed perceived control of asthma which is a measure of a patient's beliefs about his/her ability to deal with asthma and its exacerbations. Studies in nonpregnant adults find that greater perceived control is associated with better asthma-related QoL, fewer days of restricted activity due to asthma, and a significantly decreased future risk of emergency department visits and hospitalizations for asthma (20, 21). The women in this study scored higher in the perceived control of their asthma (PCAQ = 43) in comparison to the results of two previous cohort studies which reported mean PCAQ total scores of 38 (21) and 38.8 (13). Olajos-Clow et al. (22) also found an association between PCAQ and QoL in nonpregnant people with asthma. The effect of PCAQ on asthma QoL can be modified

TABLE 3.—Logistic regression for factors associated with uncontrolled asthma (ACQ > 1.5 vs. ACQ ≤ 1.5).

	Simple regression, <i>n</i> = 125		Multiple regression, <i>n</i> = 110	
	OR (95% CI)	<i>P</i> -value	OR (95% CI)	<i>P</i> -value
Age ≥ 30 years	2.55 (1.03, 6.30)	.043	5.07 (1.03, 24.88)	.046
Education > 12 years	1.52 (0.57, 4.08)	.406		
Employed	0.68 (0.27, 1.70)	.405		
Smoker	2.63 (0.96, 7.15)	.059	3.22 (0.66, 15.65)	.147
Maintenance ICS	5.98 (1.91, 18.74)	.002	6.30 (1.04, 37.96)	.045
Atopy	1.04 (0.37, 2.95)	.936		
BMI > 30	1.44 (0.49, 4.23)	.510		
FENO (log transformed)	0.72 (0.42, 1.23)	.227	0.45 (0.17, 1.19)	.108
Brief IPQ: Consequences	1.83 (1.41, 2.37)	<.001	1.23 (0.70, 2.17)	.465
Brief IPQ: Timeline	1.02 (0.88, 1.18)	.816		
Brief IPQ: Personal control	0.72 (0.61, 0.88)	.001	1.08 (0.63, 1.84)	.781
Brief IPQ: Treatment control	0.80 (0.64, 1.0)	.051	0.57 (0.32, 1.01)	.055
Brief IPQ: Identity	1.78 (1.37, 2.32)	<.001	1.50 (0.75, 2.99)	.253
Brief IPQ: Concern	1.50 (1.20, 1.86)	<.001	1.27 (0.81, 1.99)	.300
Brief IPQ: Understanding	0.99 (0.81, 1.22)	.966		
Brief IPQ: Emotional response	1.23 (1.02, 1.47)	.026	0.62 (0.41, 0.96)	.030
AQLQ-M total score	2.76 (1.76, 4.31)	<.001	1.53 (0.74, 3.18)	.249
PCAQ total score	0.89 (0.81, 0.97)	.011		
STAI-6 total score	1.04 (0.99, 1.08)	.095		
PRSE (mean ventolin/ICS/ prednisolone)	1.03 (1.01, 1.06)	.017	1.03 (0.99, 1.07)	.106

Note: ACQ, Asthma Control Questionnaire; OR, odds ratio; CI, confidence interval; BMI, pregnancy body mass index, FENO, forced exhaled nitric oxide; IPQ, Illness Perception Questionnaire; AQLQ-M, Asthma Quality of Life Questionnaire-Marks; PCAQ, Perceived Control of Asthma Questionnaire; STAI-6, Six-Item Short-Form State Trait Anxiety Inventory; PRSEs, perceived risk teratogenic side effects; ICS, inhaled corticosteroid; BDP, beclomethasone dipropionate daily dose.

TABLE 4.—Logistic regression for factors associated with adherence (80% adherent vs. <80% adherent).

	Simple regression, <i>n</i> = 65		Multiple regression, <i>n</i> = 57	
	OR (95%CI)	<i>P</i> -value	OR (95%CI)	<i>P</i> -value
Age ≥ 30 years	0.50 (0.14, 0.172)	.269		
Education > 12 years	1.89 (0.54, 6.58)	.320		
Employed	0.50 (0.14, 1.85)	.301		
Smoker	0.43 (0.12, 1.58)	.202		
Atopy	5.06 (1.37, 18.7)	.015	2.27 (0.45, 11.36)	.319
BMI > 30	0.52 (0.13, 2.12)	.358		
ACQ score > 1.5	0.59 (0.16, 2.11)	.416		
FENO (log transformed)	1.26 (0.57, 2.79)	.570		
Brief IPQ: Consequences	1.24 (0.88, 1.74)	.224	1.24 (0.63, 2.44)	.538
Brief IPQ: Timeline	1.24 (1.01, 1.52)	.041	1.08 (0.84, 1.38)	.541
Brief IPQ: Personal control	1.15 (0.85, 1.54)	.363	1.34 (0.81, 2.16)	.257
Brief IPQ: Treatment control	1.43 (0.98, 2.08)	.064		
Brief IPQ: Identity	1.24 (0.89, 1.71)	.202	1.36 (0.75, 2.48)	.314
Brief IPQ: Concern	1.03 (0.79, 1.34)	.811		
Brief IPQ: Understanding	0.87 (0.62, 1.23)	.442		
Brief IPQ: Emotional response	1.05 (0.80, 1.37)	.713		
AQLQ-M total score	0.94 (0.57, 1.55)	.815		
PCAQ total score	1.05 (0.93, 1.17)	.442		
STAI total score	0.94 (0.88, 0.99)	.019	0.94 (0.88, 1.01)	.098
PRSE (mean ventolin/ICS/ prednisolone)	0.99 (0.96, 1.03)	.665		

Note: ACQ, Asthma Control Questionnaire; OR, odds ratio; CI, confidence interval; BMI, pregnancy body mass index, FENO, forced exhaled nitric oxide; IPQ, Illness Perception Questionnaire; AQLQ-M, Asthma Quality of Life Questionnaire-Marks; PCAQ, Perceived Control of Asthma Questionnaire; STAI-6, Six-Item Short-Form State Trait Anxiety Inventory; PRSEs, perceived risk teratogenic side effects.

by asthma education, such that improving perceived control of asthma is associated with an improvement in QoL (22). This suggests opportunities for improving asthma self-management intervention in pregnancy.

Brief IPQ

Concerns about the impact of asthma and its treatment on the pregnancy and the baby are important psychological dimensions of asthma in pregnancy. It is therefore

TABLE 5.—Linear regression for factors associated with quality of life (AQLQ-M total score log transformed).

	Simple regression, <i>n</i> = 125		Multiple regression, <i>n</i> = 111	
	Coefficient (95% CI)	<i>P</i> -value	Coefficient (95% CI)	<i>P</i> -value
Age ≥ 30 years	0.20 (0.06, 0.34)	.007	0.093 (−0.02, 0.20)	.091
Education > 12 years	0.11 (−0.04, 0.26)	.156		
Employed	−0.09 (−0.24, 0.06)	.232		
Smoker	0.12 (−0.05, 0.30)	.169		
Maintenance ICS	0.35 (0.22, 0.47)	<.001	0.13 (0.02, 0.24)	.023
Atopy	0.06 (−0.11, 0.22)	.498		
BMI > 30	0.04 (−0.12, 0.21)	.628		
ACQ score > 1.5	0.41 (0.26, 0.57)	<.001	0.12 (−0.02, 0.26)	.093
FENO (log transformed)	−0.07 (−0.15, 0.01)	.069	−0.06 (−0.12, −0.01)	.028
Brief IPQ: Consequences	0.12 (0.09, 0.15)	<.001	0.04 (0.001, 0.09)	.044
Brief IPQ: Timeline	0.022 (−0.0003, 0.05)	.053	0.02 (0.004, 0.04)	.016
Brief IPQ: Personal control	−0.07 (−0.09, −0.04)	<.001	−0.02 (−0.05, 0.001)	.061
Brief IPQ: Treatment control	−0.03 (−0.07, 0.01)	.169		
Brief IPQ: Identity	0.10 (0.07, 0.13)	<.001	0.02 (−0.02, 0.06)	.231
Brief IPQ: Concern	0.07 (0.04, 0.10)	<.001	−0.03 (−0.06, 0.001)	.057
Brief IPQ: Understanding	−0.01 (−0.04, 0.03)	.757		
Brief IPQ: Emotional response	0.08 (0.06, 0.11)	<.001	0.04 (0.01, 0.06)	.015
PCAQ total score	−0.02 (−0.03, −0.01)	.005		
STAI total score	0.02 (0.01, 0.02)	<.001	0.01 (0.004, 0.015)	<.001
PRSE (mean ventolin/ICS/ prednisolone)	0.01 (0.001, 0.01)	.019		

Note: ACQ, Asthma Control Questionnaire; CI, confidence interval; BMI, pregnancy body mass index; FENO, forced exhaled nitric oxide; IPQ, Illness Perception Questionnaire; AQLQ-M, Asthma Quality of Life Questionnaire-Marks; PCAQ, Perceived Control of Asthma Questionnaire; STAI-6, Six-Item Short-Form State Trait Anxiety Inventory; PRSEs, perceived risk teratogenic side effects; ICS, inhaled corticosteroid; BDP, beclomethasone dipropionate daily dose.

important to assess the mother's beliefs about asthma (i.e., illness perception) and its treatment during pregnancy, as we did in this study. A woman's response to these perceived health threats and her approach to coping can be understood using Leventhal's self-regulation model (23). This model assesses several key dimensions of the representation of illness: identity (symptoms associated with the illness), the timeline of the illness (an acute, chronic, or episodic course), the consequences of the illness, control (patients' perceptions of exerting control over their illness), and causation (representations including patients' explanations regarding the etiology of the illness). The Brief IPQ is a validated questionnaire that assesses these domains and was developed for individuals with a range of illnesses including asthma (14). An average difference in domain score of over 1 on the 0–10 point scale is considered clinically relevant (24). There have been no prior studies of asthma illness perception during pregnancy using this measure.

Controlled asthma was associated with more positive illness perceptions. The group of pregnant women with asthma in this study reported a more positive illness perceptions on the Brief IPQ than has previously been reported in an unselected asthma population in the domains of consequences and personal control (cognitive illness representations), concern and emotional response (emotional representations), and understanding (illness comprehensibility) (14).

Better asthma symptom control was associated with higher perceived personal control over asthma and stronger identity beliefs. Similar results have been found

in other chronic illnesses such as diabetes mellitus (14). In summary, a woman's beliefs regarding the consequences of asthma during pregnancy and her ability to manage the illness relate to symptom control during pregnancy. These domains can be addressed in asthma self-management programs and reinforce the need for these interventions in the antenatal setting.

Perception of Medication Risk

Asthma medication is commonly used in pregnancy, with over 60% of pregnant women with asthma reporting use of an asthma medication during pregnancy (25). In a large pharmacoepidemiologic study of women using asthma medication, salbutamol was used by 95% and corticosteroids by 36% (25). Asthma medications have a variable but generally low risk of teratogenic effects. Both salbutamol (26) and ICSs are not recognized to increase the teratogenic risk (27). In contrast, while oral corticosteroid therapy (prednisolone) does not represent a major teratogenic risk, it has been associated with a 3.4-fold increased risk of oral cleft, an effect also demonstrated in animal studies (28). Additionally, multiple courses of corticosteroid have also been associated with neonatal sepsis (29), hypertension, and neurological and psychological impairment later in life (30), while topical steroid use has been associated with fetal growth restriction (31).

The perception of teratogenic risk may influence decisions about drug therapy in pregnancy and can modify adherence to medication (32). However, in this analysis, we found no effect on ICS adherence, but this was

limited by reduced power (53% of the women taking maintenance ICS) and self-reported adherence. In asthma specifically, accurate perception is particularly important since nonadherence to low-risk agents such as ICS could lead to increases in asthma exacerbation (7, 8), which may require OCS therapy. In this situation, inaccurate perception of medication risk and resultant nonadherence will expose the fetus to the adverse effects of a severe exacerbation or the potential effects of OCS. Enriquez et al. (33) used a pharmacy claims database to study this and found that between 5 and 13 weeks of pregnancy there was a significant decrease in the use of short-acting β_2 -agonists and ICSs.

Women identified a greater risk associated with oral corticosteroid when compared with ICS and β_2 -agonists. However, they inaccurately identified a teratogenic risk associated with ICS and β_2 -agonist use and overestimated the magnitude of teratogenic effects for all classes of asthma drugs. Overestimation of teratogenic effects has been observed in other situations (32, 34). In this study, women significantly overestimated the teratogenic effects of OCS. This is a significant concern, since poor asthma control is a risk for future asthma exacerbations, which may require OCS for therapy, and inaccurate perception of OCS risk may lead to nonadherence with OCS when it is needed to treat the exacerbation.

Anxiety

Asthma can be associated with an increased prevalence of anxiety disorder that can impact on management and symptom manifestations (35). Some studies in respiratory outpatient clinics report high levels of anxiety in asthmatics of between 38% and 52% (36, 37). Increased anxiety has been found to be independently associated with poorer asthma control and increased healthcare utilization in previous studies of adults with asthma (38, 39). Pregnancy itself has not been linked to an increased prevalence of anxiety disorder (40); however, anxiety in pregnancy has been linked to an increased prevalence of asthma in offspring (41). The anxiety scores in this population of pregnant women with asthma were related to QoL impairment but not poor asthma control.

One limitation of this study is its cross-sectional design, where the illness perceptions and asthma control variables were assessed at the same time. Consequently, the results only provide evidence on the relationships between variables and suggest potential explanations, but do not provide causal evidence for these relationships. This indicates the need for a longitudinal, interventional study which would be able to address changes in illness perceptions during pregnancy and, after a targeted intervention, investigate the causal nature of the relationships observed in this study. These findings are relevant to women with asthma attending an antenatal clinic who in general have mild asthma and their level of asthma control reflects that observed in people with mild asthma in the community. The results of the study emphasize the importance of addressing patients' illness perceptions as a starting point for further interventions targeted

at self-management improvements and optimization of treatment outcomes for asthma during pregnancy.

In conclusion, pregnant women with asthma experience relatively good QoL and have generally positive illness perceptions. However, the need for maintenance ICS has a detrimental impact on psychosocial outcomes. Women with uncontrolled asthma have more negative illness perceptions. Both the poor illness perception and misperception of medication side effects could be addressed by an education and behavioral modification program, and the data in this article give direction to the content areas to target in designing such a program for women with asthma during pregnancy.

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DECLARATION OF INTEREST

PGG has received payment for reimbursement of meeting/travel expenses from GlaxoSmithKline, AstraZeneca, Novartis, and BoehringerIngelheim. MJH, KMcC, WG, HP, VLC, and VEM declare no conflict of interest.

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APPENDIX 1. The Brief Illness Perception Questionnaire (14).

1. How much does your asthma affect your life?											
no affect at all	1	2	3	4	5	6	7	8	9	10	severely affects my life
2. How long do you think your asthma will continue?											
a very short time	1	2	3	4	5	6	7	8	9	10	forever
3. How much control do you feel you have over your asthma?											
absolutely no control	1	2	3	4	5	6	7	8	9	10	extreme amount of control
4. How much do you think your treatment can help your asthma?											
not at all	1	2	3	4	5	6	7	8	9	10	extremely helpful
5. How much do you experience symptoms from your asthma?											
no symptoms at all	1	2	3	4	5	6	7	8	9	10	many severe symptoms
6. How concerned are you about your asthma?											
not at all concerned	1	2	3	4	5	6	7	8	9	10	extremely concerned
7. How well do you feel you understand your asthma?											
don't understand at all	1	2	3	4	5	6	7	8	9	10	understand very clearly
8. How much does your asthma affect you emotionally?											
not at all affected emotionally	1	2	3	4	5	6	7	8	9	10	extremely affected emotionally

APPENDIX 2. Some pregnant women have concerns about the effects of their asthma medication on their unborn baby. We would like to find out if you have any worries and concerns.

Please place a cross on the line between 0% and 100% where you think the medication may have side effects for your baby from no side effects to severe side effects (e.g. deformity)

Let the research nurse know if you are not familiar with the treatment.



Familiar with medication: **YES/NO**

Ventolin
(blue)

0%
No side Effects
(healthy baby)

100%
Severe side effects
(e.g. deformity)






Familiar with any of these medications: **YES/NO**

Preventers:
Inhaled
Corticosteroids

0%
No side Effects
(healthy baby)

100%
Severe side effects
(e.g. deformity)



Familiar with medication: **YES/NO**

Prednisolone
(white)

0%
No side Effects
(healthy baby)

100%
Severe side effects
(e.g. deformity)

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