

Original Article

Management of asthma by pregnant women attending an Australian maternity hospital

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Aims: The safety of preventive asthma medicines during pregnancy has already been established. The aim of this study was to assess asthma management by women during pregnancy.

Methods: Pregnant women attending the out-patient clinics of an Australian maternity hospital completed a questionnaire about their asthma medication use and symptoms. Parameters associated with changes in asthma medicine use are presented as odds ratio with a 95% confidence level. *P*-values <0.05 indicated statistical significance.

Results: Participants (*n* = 102) self-reported worsening of their asthma symptoms during pregnancy compared with the pre-pregnancy period, both during the day (*P* = .003) and night (*P* = .044). The number of participants whose asthma was treated by a medical professional decreased from 81 (79.4%) before pregnancy to 67 (65.7%) during pregnancy (*P* = .008). The use of regular asthma medicines (preventers and symptom controllers alone or in combination) decreased during pregnancy (*P* < .001 and *P* = .012, respectively), while the use of intermittent therapies (relievers) increased (*P* = .004) during pregnancy.

Being treated by a medical professional during pregnancy (*P* = .033), a history of asthma medicine use before pregnancy (*P* = .015) and younger age of first asthma diagnosis (*P* = .046) were associated with the use of asthma medicines during pregnancy.

Conclusions: Despite worsening of asthma symptoms, many pregnant women do not take regular preventive asthma medicines. Ongoing assessment of asthma control during pregnancy, medication review and adjustments in therapy by health professionals might facilitate asthma management.

Key words: asthma, health beliefs, medication use, pregnancy, preventers.

Introduction

Asthma is the most common chronic health condition among pregnant Australian women. It occurs in approximately 12% of pregnancies.^{1,2} Adherence to respiratory medicines has been extensively studied in non-pregnant populations; medication adherence is on average 68.8%.³ Poor adherence to regular (preventive) medicines is one of the main causes of sub-optimal clinical control of asthma, resulting in exacerbations and high social and financial costs to the health system.³ Poor control of asthma during pregnancy could increase the risk of having

a low birth weight infant,⁴⁻⁶ preterm birth⁴⁻⁷ and pre-eclampsia.⁴⁻⁷ On the other hand, well-controlled maternal asthma has been shown to decrease the risks of congenital malformations and birth and delivery complications.⁸

The safety of regular preventive asthma medicines has been confirmed in systematic reviews.^{9,10} The Australian Drug Evaluation Committee has categorised all inhaled asthma medicines under pregnancy safety category A or B.¹¹ Medicines in these categories have no proven harmful effects on the fetus and therefore, should not be discontinued during pregnancy without medical consultation.

Intentional non-adherence occurs when patients make rational decisions not to take their treatment as instructed. In such a situation, the patient rejects the medical diagnosis and/or the recommended treatment after considering factors that they believe are relevant.¹² Personal and social circumstances are likely to influence the patient's perceptions and decision-making. This is often based on a personal cost or risk versus benefit analysis of the treatment, where the

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costs and/or risks of each treatment are weighed against the benefits as the patient perceives them.¹³ Limited information is available on the nature and extent of asthma medicine usage during pregnancy. This study aimed to explore changes in asthma symptoms and medicine usage during pregnancy and factors associated with usage.

Materials and Methods

This study was part of a 2009 population-based survey of pregnant women that explored the use of medicines for chronic health conditions during pregnancy.¹⁴ Women presenting for their 36th week antenatal visit at the pregnancy clinic of The Royal Women's Hospital in Melbourne were invited to complete an anonymous questionnaire. Women <18 years of age and/or unable to communicate in English were excluded. The first part of the questionnaire had 28 items and was completed by all pregnant women. Part two (33 items) focusing on asthma symptoms, use of medicines for asthma and patient health beliefs was completed only by pregnant women who self-reported asthma. Asthma symptom classification was based on the Global Initiative for Asthma (GINA) 2008 Guidelines.¹⁵ Asthma medication use information was collected according to the National Asthma Council classification.¹⁶ Twenty-four items from the Beliefs and Behaviour Questionnaire¹⁷ covering all the factors of the Becker and Maiman model¹⁸ were selected, reworded slightly to suit pregnant patients, and included in the questionnaire to study patient beliefs, attitudes and behaviour associated with asthma and its management during pregnancy. The questionnaire was pilot-tested in 35 pregnant women (five of whom had asthma) attending the pregnancy clinic for their 36th week antenatal visit. No changes were made to the questionnaire based on feedback from the pilot phase; hence, the pilot data were included in the final analysis.

One of the researchers (ES) handed out the questionnaire and a general information sheet to women waiting for their clinic appointments in the waiting area of the pregnancy clinic. Women were asked to complete the questionnaire in the waiting area and return to the researcher. Alternatively, participants could complete the survey at their leisure and return to the investigators in the reply-paid envelope provided by the researcher. This study focuses on participant responses to part two of the questionnaire, the section on asthma.

The prevalence of asthma in the Australian general population is 12.4%.¹ It was estimated that approximately 1000 pregnant women would need to be approached to identify a convenience sample of 100 pregnant women with asthma for this study.

Data were analysed using the STATISTICAL PACKAGE FOR SOCIAL SCIENCES (Version 15.9; SPSS Inc Chicago, IL, USA). Changes in asthma symptoms before and after pregnancy were compared using the Wilcoxon Signed Rank Test. Changes in health professionals managing asthma and medicine use before and during pregnancy were compared

using McNemar's test. Factors associated with the use of asthma medicines during pregnancy were identified in univariate analysis using Chi-square test, Mann-Whitney *U* test or Student's *t*-test as appropriate. Significant variables ($P < .05$) were further analysed in a binary logistic regression model. The results are reported as odds ratios (OR) with 95% confidence intervals (95% CI).

This study was approved by the Human Ethics Committee of The Royal Women's Hospital and the Monash University Human Research Ethics Committee.

Results

A total of 1037 questionnaires were handed out, of which 913 (88.0%) were returned. Questionnaires that were incomplete (more than 5% of the items unanswered in part one) were excluded. This left 819 responses for inclusion in the final analysis, yielding an effective participation rate of 79.0%. Of these, 104 (12.7%) respondents self-reported asthma during pregnancy. Two cases were further excluded because of large amounts of missing data in part two. Table 1 summarises the demographics of these 102 participants who self-reported asthma.

Self-reported asthma symptoms were found to worsen significantly during pregnancy compared with pre-pregnancy,

Table 1 Demographics of participants with asthma ($n = 102$)

Characteristic	
Age in years: mean $\pm$ standard deviation (range)	30.2 $\pm$ 4.9 (18–41)
Age in years when asthma was first diagnosed: mean $\pm$ standard deviation (range)	11.8 $\pm$ 8.0 (0–34)
Number of fetuses carrying: mode (range)	1 (1–2)
Number of previous pregnancies: mode (range)	0 (0–7)
Number of children: mode (range)	0 (0–5)
Marital status	
Married	60 (58.8)
Cohabiting/partnered/de facto	39 (38.2)
Single	3 (2.9)
Smoking history	45 (44.1)
Smoker at time of the study	8 (7.8)
Smoker in household	33 (32.4)
Born in Australia	78 (76.5)
Highest level of education	
University education	57 (55.9)
Technical/further education	24 (23.5)
High school	11 (10.8)
Below High school	10 (9.8)
Annual household income in Australian Dollars*	
Below 50 000	27 (26.5)
50 001–75 000	26 (25.5)
75 001–100 000	18 (17.6)
Above 100 001	29 (28.4)

*Not all items add up to 102 because of missing data.

Values are number (percentage) unless stated otherwise.

Table 2 Daytime and night-time asthma symptoms before and during pregnancy ($n = 102$)

Symptoms*	Daytime		Night-time	
	Before pregnancy number (%)	During pregnancy number (%)	Before pregnancy number (%)	During pregnancy number (%)
Intermittent	83 (81.4)	76 (74.5)	72 (70.6)	66 (64.7)
Mild persistent	13 (12.7)	13 (12.7)	14 (13.7)	13 (12.7)
Moderate persistent	5 (4.9)	11 (10.8)	10 (9.8)	13 (12.7)
Severe persistent	1 (1.0)	2 (2.0)	6 (5.9)	10 (9.8)

*Symptom severity based on the asthma pattern classification by the Global Initiative for Asthma (GINA) 2008.

both during day ($P = .003$) and night ($P = .044$). Day-time and nocturnal symptoms are summarised in Table 2. The number of participants whose asthma was treated by a medical professional decreased from 81 (79.4%) before pregnancy to 67 (65.7%) during pregnancy ($P = .008$). The number of participants who used some form of pharmacological treatment for their asthma decreased from 94 (92.2%) before pregnancy to 77 (75.5%) during pregnancy ($P < .001$). The use of regular asthma medicines – preventers [inhaled corticosteroids (ICSs)] and symptom controllers (long-acting beta agonists, anticholinergics, leukotriene antagonists, cromones and xanthine derivatives), alone or in combination – decreased during pregnancy ($P < .001$ and $P = .012$, respectively), while the use of intermittent therapies – relievers (short-acting beta agonists) increased ($P = .004$) during pregnancy. Details of usage are given in Table 3.

Response to statements on health beliefs and medication use are given in Tables 4 and 5, respectively. The majority of participants were confident that their current management of asthma would keep asthma symptoms at bay and did not feel that asthma management disrupted their life. The majority said they strived to follow the instructions of their doctor, although frequent deviations from recommended

management were reported by more than one-third of respondents.

In univariable analysis, asthma being managed by a medical professional during pregnancy, asthma managed by a medical professional before pregnancy, using asthma medicines before conception and younger age of first asthma diagnosis (10.8 ± 7.6 vs 14.9 ± 8.5 years; $P = .031$) were factors significantly associated with the usage of asthma medicines during pregnancy. The proportions of asthma medicine users versus non-users in the study cohort for the first three characteristics were 60 (77.9%) versus nine (36.0%), $P < .001$; 67 (87.0%) versus 14 (56.0%), $P = .001$; and 76 (98.7%) versus 18 (72.0%); $P < .001$, respectively. Asthma severity, symptoms and patient health beliefs had no effect on asthma medicine usage during pregnancy. In multivariable analysis, management of asthma during pregnancy by a medical professional OR (95% CI) 4.25 (1.12–16.07); $P = .033$, use of asthma medicines before conception 16.4 (1.73–155.2); $P = .015$ and younger age of asthma diagnosis 0.932 (0.870–0.999); $P = .046$ were independent predictors of asthma medicine usage during pregnancy. The binary logistic regression model explained 37.3% of the variance in the usage of asthma medicines during pregnancy.

Table 3 Pharmacological management of women with asthma before and during pregnancy ($n = 102$)

Management	Before pregnancy number (%)	During pregnancy number (%)
Preventer only	6 (5.9)	2 (2.0)
Reliever only	55 (53.9)	58 (56.9)
Symptom controller only	1 (1.0)	0 (0.0)
Combination	32 (31.4)	17 (16.7)
Preventer and reliever	13 (12.7)	6 (5.9)
Preventer and symptom controller	3 (2.9)	3 (2.9)
Preventer, reliever and symptom controller	16 (15.7)	8 (7.8)
No pharmacological treatment	8 (7.8)	25 (24.5)

Preventers: inhaled corticosteroids; Relievers: short-acting beta agonists; Symptom controllers: long-acting beta agonists, anticholinergics, leukotriene antagonists, cromones and xanthine derivatives.

Discussion

A number of issues associated with the management of asthma during pregnancy, such as worsening of asthma symptoms, inadequate review of asthma management, active and passive exposure to smoking and under-utilisation of asthma medicines have been identified. Our findings are in line with those of Reid *et al.*'s¹⁹ postal survey of young adults (22–44 years) in Melbourne, Australia, where only one-tenth of all subjects with asthma were found to use ICSs on a daily (and truly prophylactic) basis, irrespective of symptoms. Involvement of a medical practitioner in asthma management during pregnancy, use of asthma medicines before conception and younger age of asthma diagnosis were found to be associated with improved asthma medication use during pregnancy, while asthma severity, symptoms and patient health beliefs had no effect. Despite worsening of day-time and night-time asthma symptoms, the use of pharmacological treatment was found to decline during pregnancy. The usage of regular asthma medicines – ICSs

Table 4 Participant responses to the health beliefs statements ($n = 102$)

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I have sufficient understanding about asthma	0	2 (2.0)	10 (9.8)	58 (56.9)	31 (30.4)
Poor asthma control during pregnancy increases the risk of complications	0	7 (6.9)	25 (24.5)	54 (52.9)	15 (14.7)
I have concerns about the effects of asthma on my baby	4 (3.9)	37 (36.3)	31 (30.4)	19 (18.6)	10 (9.8)
Most asthma medicines are safe to use during pregnancy	2 (2.0)	13 (12.7)	41 (40.2)	42 (41.2)	4 (3.9)
The management of asthma disrupts my life	39 (38.2)	49 (48.0)	7 (6.9)	5 (4.9)	2 (2.0)
I am currently on too many medicines for the treatment of my asthma	61 (59.8)	37 (36.3)	3 (2.9)	0	0
I am concerned about the effects of asthma medicines on my baby	15 (14.7)	40 (39.2)	19 (18.6)	18 (17.6)	9 (8.8)
I am satisfied with the information my doctors share with me about my asthma	2 (2.0)	7 (6.9)	20 (19.6)	54 (52.9)	19 (18.6)
The current management of my asthma will keep my symptoms at bay	0	6 (5.9)	17 (16.7)	57 (55.9)	22 (21.6)
It is helpful to know the experiences of other pregnant women with asthma	1 (1.0)	7 (6.9)	32 (31.4)	50 (49.0)	12 (11.8)
I have a say in the way my asthma is managed	0	1 (1.0)	18 (17.6)	55 (53.9)	28 (27.5)
Using any medicine during pregnancy carries some risk	3 (2.9)	13 (12.7)	16 (15.7)	51 (50.0)	19 (18.6)
My health professionals have discussed with me the safety of all my medicines during pregnancy	0	6 (5.9)	16 (15.7)	46 (45.1)	34 (33.3)
Natural remedies are safer than other medicines during pregnancy	6 (5.9)	38 (37.3)	26 (25.5)	22 (21.6)	10 (9.8)
I have a say in the way my health conditions are managed during pregnancy	0	1 (1.0)	12 (11.8)	54 (52.9)	35 (34.3)
Financial difficulties limit my access to the best health care during pregnancy	24 (23.5)	36 (35.3)	15 (14.7)	18 (17.6)	9 (8.8)

Responses do not add up to 102 because of missing responses.
Values are number (percentage).

Table 5 Participant responses to the statements on medication use ($n = 102$)

Statement	Always	Often	Sometimes	Rarely	Never
I have strict routines for using my regular medicines	19 (18.6)	26 (25.5)	21 (20.6)	19 (18.6)	15 (14.7)
I keep my medicines close to where I need to use them	49 (48.0)	28 (27.5)	16 (15.7)	3 (2.9)	6 (5.9)
I ensure I have enough medicines so that I don't run out	41 (40.2)	34 (33.3)	21 (20.6)	2 (2.0)	4 (3.9)
I strive to follow the instructions of my doctors	47 (46.1)	35 (34.3)	16 (15.7)	0	3 (2.9)
I get confused about my medicines	2 (2.0)	1 (1.0)	13 (12.7)	28 (27.5)	58 (56.9)
I make changes in the recommended management to suit my lifestyle	13 (12.7)	27 (26.5)	32 (31.4)	15 (14.7)	15 (14.7)
I vary my recommended management based on how I am feeling	11 (10.8)	26 (25.5)	30 (29.4)	18 (17.6)	17 (16.7)
I put up with my medical problems before taking any action	10 (9.8)	13 (12.7)	36 (35.3)	30 (29.4)	13 (12.7)

Responses do not add up to 102 because of missing responses.
Values are number (percentage).

and long-acting beta agonists – decreased, while the use of relievers – short-acting beta agonists – increased. Patient nonadherence to treatment recommendations and/or prescriber nonadherence to treatment guidelines could be contributing to these deviations. Patient self-reported changes in medication use were not appropriate for the self-reported asthma severity, regardless of who initiated those changes.

Our findings confirm the suboptimal management of asthma during pregnancy. Murphy *et al.*²⁰ in a study of

pregnant women with a doctor diagnosis of asthma recruited through the antenatal clinics of an Australian hospital at 20 weeks gestation found that 40% were nonadherent with ICS medication, 16% had inadequate inhaler technique and 42% had inadequate knowledge about their prescribed medications. Enriquez *et al.*²¹ determined asthma-specific medication use based on Tennessee Medicaid pharmacy claim files and found that women decrease and/or stop asthma medications during early pregnancy despite national guidelines recommending continued use.²¹ It is likely that

pregnant women in our study too were not using their regular asthma medicines without informing their prescribers.

Physician–patient relationship was shown to be strongly associated with patient adherence and satisfaction with treatment in a study of young patients (mean age 38.9 years) with chronic health conditions, including asthma.²² Reid *et al*¹⁹ found that patients with asthma who had been seen by a doctor within the preceding year were more than twice as likely to be compliant with ICSs compared with those who had not. In our study, asthma being managed by a medical professional before and during pregnancy increased the likelihood of using asthma medicines during pregnancy, confirming the vital role of medical professionals in promoting patient persistence with asthma treatment. Ongoing assessment of asthma control, including medicine review and adjustment, is recommended by the Australian asthma management guidelines.²³ Pre-pregnancy asthma severity and use of medication according to guidelines had significant and profound effects on the course of asthma in a study of 872 pregnant women who had physician-diagnosed asthma.²⁴ Women with milder asthma received most benefit from appropriate treatment: 62% decreased risk for worsening asthma among those with intermittent asthma and 52% decreased risk among those with mild persistent asthma.²⁴

Patients taking regular medicines engage in an implicit cost–benefit analysis, in which beliefs about the necessity of their medicines are weighed against concerns about the potential adverse effects or difficulties of taking it. This in turn determines their medicine adherence and persistence.¹³ In order to facilitate informed adherence, medical professionals should utilise more effective ways to communicate the relative benefits over the risks of recommended treatment to patients with asthma who are pregnant or planning to become pregnant. Equally important is the need to address patient concerns about potential adverse effects of medicines, especially on the fetus.

Age at which asthma was diagnosed was an independent predictor of the use of asthma medicines during pregnancy. This has not been reported in the literature before. ‘Routinisation’ is a key factor influencing patient adherence to chronic medicines.²⁵ It is possible that patients who had asthma diagnosed at a younger age had been able to incorporate medicine use into their routines and hence, had no difficulties in persisting with their medicines even after becoming pregnant. The finding that the use of asthma medicines before conception predicted the use of asthma medicines during pregnancy further supports this argument.

Our study has some strengths and limitations. This study was carried out in a large maternity hospital in Australia and assessed asthma management throughout pregnancy. The study might have missed women who delivered before 36 weeks of pregnancy. The mean gestation period for women with asthma is known to be >36 weeks,^{10,26} hence, it is unlikely that we have missed many pregnant women with asthma. Nevertheless, uncontrolled asthma is associated with pre-term birth and pre-eclampsia;^{4–7} it is possible that we

missed some of these women, especially those with severe forms of asthma. The study sample is representative of the general pregnant population in urban Australia in terms of demographics, although our study included a higher proportion of women with university education.^{19,27} However, exclusion of women who could not communicate in English might have resulted in under-representation of ethnic minorities with a non-English-speaking background in the study. We did not distinguish patient non-adherence to preventive treatments from prescribed reduction in medicine use, not only because we did not have access to medical and pharmacy records but also because of the anonymous nature of our survey. Future research should assess medical practitioners’ adherence to treatment guidelines and patient adherence to asthma management recommendations concomitantly.

In our study, pregnant women attending the 36th week antenatal clinic were chosen for the study to have an understanding of asthma medicine use before and during all three trimesters of pregnancy; however, this might have resulted in respondent recall bias and over-reporting of medicine use, especially with regard to the pre-pregnancy period. The extent of medication non-adherence and prevalence of smoking observed in this study is likely to be an underestimation. Participants were approached while waiting in the clinic and were not specifically asked to report their medication use in various trimesters and any specific time-period before pregnancy in order to reduce the length of the questionnaire and minimise recall bias. Although it was an anonymous questionnaire, it is possible that women with less healthy lifestyles chose not to participate in our research. Self-reports for assessing the prevalence of medical conditions and medicine use are prone to respondent bias. The accuracy of patient self-report in our study was not verified against any records or objective measures. Nevertheless, those who reported discontinuation of their medicine use were likely to be telling the truth. Use of inhaled and rescue corticosteroids has been shown to rebound in the second trimester, although usage remains lower than pre-pregnancy levels.²¹ Future studies should investigate usage of asthma medicines during various trimesters and health outcomes longitudinally. Interventions for improving asthma medicine use during pregnancy should also be developed and tested.

Asthma is a common health condition among pregnant women in many countries, including Australia. Despite worsening of asthma symptoms, many women do not take regular preventive asthma medicines during pregnancy. Ongoing assessment of asthma control during pregnancy, medicine review and adjustments in therapy by health professionals might facilitate asthma management, improve persistence with preventive medicines in turn reducing asthma symptoms during pregnancy.

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