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Asthma Symptoms, Control, and Pregnancy Outcomes Among Pregnant Women in Kassala, Sudan: A Cross-Sectional Study

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Abstract

Objective: This study aimed to evaluate asthma symptoms, triggering factors, disease control, severity, and pregnancy outcomes among pregnant women with asthma in Kassala, Sudan.

Methods: This was a descriptive cross-sectional hospital-based study that included pregnant women diagnosed with asthma at Kassala Women and Obstetrics Hospital, in the Sudan, from June to December 2024. The data were obtained through a structured questionnaire and analyzed with SPSS version 26. Descriptive and inferential statistical measures were used with a p value of less than or equal to 0.05 deemed statistically significant.

Results: A total of 50 pregnant women with asthma were included in the study. Shortness of breath, cough, chest tightness, and wheezing were the most frequently reported symptoms. More than half of the participants reported worsening of asthma symptoms during pregnancy. Smoking exposure and air pollution were the most commonly reported triggering factors. Although 72.0% of participants reported regular asthma treatment, only 22.0% achieved well-controlled asthma, while 50.0% had uncontrolled disease. Asthma exacerbations during pregnancy were common, and poor pregnancy outcomes were significantly associated with older maternal age, recent asthma diagnosis, and depression or anxiety.

Conclusion: The study population showed that asthma during pregnancy was associated with poor control of symptoms, high rates of exacerbations and significant levels of exposure to environmental triggering factors. Early diagnosis, regular monitoring, improved treatment adherence, and multidisciplinary care may contribute to improved maternal and fetal outcomes among pregnant women with asthma.

Keywords: Asthma Control, Asthma Exacerbation, Pregnancy Outcomes, Maternal Health, Respiratory Symptoms, Inhaled Corticosteroids

Introduction

Asthma is a chronic inflammatory airway disease characterized by variable respiratory symptoms, including wheezing, shortness of breath, chest tightness, and cough, accompanied by variable expiratory airflow limitation [1]. It is one of the most common chronic medical conditions affecting pregnant women worldwide and remains an important contributor to maternal and fetal morbidity.

Pregnancy is associated with several physiological, hormonal, and immunological changes that may alter the clinical course of asthma. During pregnancy, increased oxygen consumption, progesterone-mediated hyperventilation, increased tidal volume, and reduced functional residual capacity (FRC) may contribute to worsening respiratory symptoms and impaired asthma control [2]. In addition, pregnancy-induced immune system modifications, including a shift toward T-helper 2 immune predominance, may increase susceptibility to asthma exacerbations [3]. Upper airway edema and rhinosinusitis may also affect respiratory function during pregnancy because of hormonal influences [4].

Asthma is a disease that impacts some 262 million people worldwide and is a significant cause of years lived with disability in the world [5]. Despite progress, asthma is still underdiagnosed and inadequately managed in sub-Saharan Africa, with a lack of symptom control, frequent exacerbations and resulting high health burdens [6]. Limited access to specialized care, inadequate healthcare resources, poor follow-up, and environmental exposures further complicate asthma management in low-resource

settings.

Low birth weight, perinatal death, congenital anomalies, low fetal weight, preeclampsia and spontaneous abortion are adverse maternal and fetal outcomes associated with poor asthma control during pregnancy [7]. This has been reported in the obstetric respiratory literature [8], as a consistent finding. Previous studies found that symptoms of asthma worsen in about 33% of women with asthma and that more than 45% of pregnancies complicated by asthma experienced one or more exacerbations necessitating medical intervention [9]. Smoking exposure, suboptimal use of inhaled medicines, other preexisting health conditions and environmental factors are also found to play a role in poorly controlled asthma in pregnancy [10].

Achieving optimal asthma management during pregnancy will involve frequent clinical check-ups, following prescribed asthma therapy, avoidance of asthma triggers, and multidisciplinary care with respiratory and obstetric specialists [11]. Although international guidelines for asthma management have improved in recent years, asthma episodes and low asthma control are prevalent in pregnant women, especially in limited resource health care settings where the monitoring and availability of specialist care might be less than desired [12].

Although several international studies have investigated asthma control and pregnancy outcomes, limited published evidence is available regarding asthma symptoms, triggering factors, disease control, severity, and pregnancy outcomes among pregnant women in Sudan. Knowledge of these factors is necessary to ensure an improvement of the asthma management strategy, as well as maternal health-related services in low-resource areas. Hence, this study was carried out to determine the extent of asthma symptoms, triggering factors, asthma control, asthma severity and pregnancy outcome among pregnant women in Kassala women and obstetrics hospital Sudan.

Materials and Methods

Study Design and Setting

This study was a descriptive cross-sectional hospital-based study conducted among pregnant women with asthma attending Kassala Women and Obstetrics Hospital, Kassala, Sudan. Kassala Women and Obstetrics Hospital (KWO) is one of the key maternal health facilities in eastern Sudan, with healthcare services for women's health conditions, preconception counseling, antenatal care, childbirth, postpartum care and other services. The hospital is a referral centre for maternal health care services in the region as patients are referred from rural areas and from the Kassala city itself. The study was carried out for six months from June to December 2024.

A cross-sectional design was considered appropriate because it enabled assessment of asthma symptoms, triggering factors, asthma control, severity, and pregnancy outcomes among participants during the study period. The study was also to find out factors affecting poor asthma outcomes among the participants.

Study Population

The study population was pregnant women diagnosed with asthma attending Kassala Women and Obstetrics Hospital in the period of the study. Enrollment of participants was done following the verification of their eligibility based on inclusion and exclusion criteria. All pregnant women with known asthma, irrespective of their gestation, parity or duration of diagnosis were eligible for the study.

Pregnant women with asthma-like respiratory symptoms, as well as with other chronic respiratory disease or acute respiratory state which might affect the evaluation of asthma related symptoms was not included. Further, women who did not participate or declined to consent were excluded from the study.

Sample Size and Sampling Technique

The single population proportion formula with a 95 % confidence interval and a z value of 0.05 and a known population proportion of 0.5 was used to determine the minimum sample size needed. A minimum sample size of 384 participants was calculated. However, 50 pregnant women with asthma were selected due to limited number of eligible asthmatic pregnant women attending the study setting for the study period.

The non-probability total coverage sampling technique was used in selecting eligible participants. All pregnant women with asthma who had visited the hospital during the study period and met the eligibility criteria were asked about participation. This sampling method was deemed to be suitable as there were only few number of eligible cases available within the duration of the study.

Data Collection Tool and Procedure

The data were obtained through a structured standardized questionnaire that was directly filled-out by the researcher. The questionnaire was designed to meet the goals of the study and contained various sections of socio-demographic data, obstetric history, asthma symptoms, triggering factors, evaluation of asthma control, severity evaluation, medication use, co-morbidities, and pregnancy outcomes.

Socio-demographic data was collected from the respondents such as age and occupation. Obstetric information comprised gravidity, parity and gestational age. Participants were also questioned regarding the time elapsed and when the asthma was diagnosed, either as a child, adult or recently prior to pregnancy.

Asthma-related symptoms measured during the study included wheezing, shortness of breath, cough and chest tightness during and outside pregnancy. Additionally, participants were asked to identify and/or recall common factors that contribute to asthma exacerbation such as smoking, air pollution, cold air, perfumes, viral infections, wind, strong smells, food triggers and exposure to insect or animals.

Symptom based clinical measures of asthma control included daytime symptoms, night symptoms, limitation of daily activities and the use of reliever medication in the previous 4 weeks. Asthma severity was assessed based on the following parameters: exacerbation frequency, healthcare consumption, hospitalizations, intensive care unit admission and frequency of short-acting beta-agonist (SAB) use. Information on adherence to medication, including the adherence of inhaled corticosteroid was also secured [13].

The questionnaire further assessed the prevalence of co-morbid conditions often seen during pregnancy and associated with asthma such as allergic rhinitis, eczema, gastroesophageal reflux disease, obstructive sleep apnea, food allergy, drug allergy, depression, anxiety, etc. Poor pregnancy outcomes were defined as exacerbation of asthma symptoms, recurrent exacerbation, hospitalization or poor

maternal asthma status during pregnancy.

Statistical Analysis

The collected data were checked for completeness, coded and entered into Statistical Package for Social Sciences (SPSS) version 26 for analysis. The Descriptive Statistical Analysis was used for summarizing the characteristics of the study participants and the study variables. Results of numerical variables were expressed as mean and standard deviation and categorical variables by frequency and percentages.

In order to understand relationship between asthma related factors, co-morbidity factors and pregnancy outcomes among the study subjects, inferential statistical analysis was done by Chi-square test. The statistical significance p value was set at < 0.05.

Ethical Considerations

The study protocol was approved by the Sudan Medical Specialization Board and Council of Respiratory Medicine. Before starting data collection, ethical clearance was also sought from the relevant Ethics and Development Committee (EDC).

All participants had their written informed consent obtained before they were recruited for the study. Participants were made aware of the aims and purpose of the research and the fact that their participation was entirely voluntary. They were also told that they can stop participating in the study at any time and for any reason without any consequences or loss of services.

The use of coded questionnaires and anonymized data collection procedures ensured confidentiality and privacy in the handling and collection of participant information throughout the study. Any data gathered was treated with confidentiality and only used for research.

Results

Participant Characteristics

This study examined 50 pregnant women who had diagnosis of asthma being treated. Almost half of the participants aged between 20-35 years (48.0%) and 44.0% aged between 36-50 years. The age group were under 20 years 6.0% and one participant was above the 50 years of age category 2.0%. Most participants were housewives (74.0%), 14.0% was worker, 10.0% was governmental sector employee and 2.0% was private sector employee.

When asked about obstetric characteristics, 44.0% of the participants had second trimester pregnancy, 32.0% third trimester and 24.0% first trimesters. The gravidity of the participants had a mean of 3.42 ± 2.07 and the mean of their parity was 2.0 ± 2.0 (Table 1).

Table 1: Demographic and obstetric characteristics of study participants (N = 50)

Variable	Category	n (%)
Age (years)	<20	3 (6.0)
	20–35	24 (48.0)
	36–50	22 (44.0)
	>50	1 (2.0)
Occupation	Housewife	37 (74.0)
	Government employee	5 (10.0)
	Worker	7 (14.0)
	Private sector employee	1 (2.0)
Gestational age	First trimester	12 (24.0)
	Second trimester	22 (44.0)
	Third trimester	16 (32.0)
Gravidity	Mean ± SD	3.42 ± 2.07
Parity	Mean ± SD	2.0 ± 2.0

Asthma Characteristics and Symptom Profile

Regarding the duration of asthma diagnosis, 44.0% of the subjects had been diagnosed with asthma as children and 40.0% as adults. There were 16.0% asthma cases that were recently diagnosed (Table 2).

The most common asthma symptom reported during pregnancy was shortness of breath, with 66.0% participants reporting this symptom, followed by cough (52.0%), chest tightness (46.0%), and wheezing (26.0%). Similar symptom patterns were observed outside pregnancy, but wheezing was more common outside than during pregnancy (38.0% vs 26.0%) (Fig 1).

Table 2: Asthma diagnosis and symptom characteristics among study participants (N = 50)

Variable	Category	n (%)
Duration of asthma diagnosis	Since childhood	22 (44.0)
	Since adulthood	20 (40.0)
	Recently diagnosed	8 (16.0)
Symptoms during pregnancy	Shortness of breath	33 (66.0)
	Cough	26 (52.0)
	Chest tightness	23 (46.0)
	Wheezing	13 (26.0)

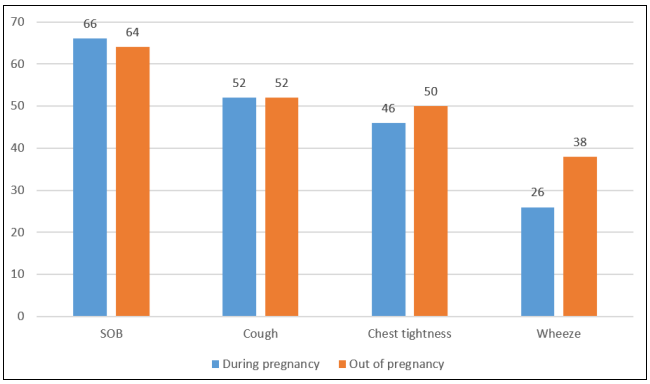

Fig 1: Frequency of asthma symptoms during and outside pregnancy among study participants (N = 50)

Triggering Factors of Asthma

Smoking exposure and air pollution were the top reported triggering factors during pregnancy at 40.0% each. Colder weather was reported by 32.0% of the participants, followed by weather changes (30.0%), insects and animals (22.0%), strong smell (22.0%), viral infections (16.0%), perfumes (12.0%) and food related triggers (6.0%).

When it comes to triggers outside pregnancy, cold air was another top one (38.0%), as were air pollution (40.0%), smoking exposure (32.0%), viral infection (24.0%), weather changes (26.0%) and exposure to insects and animals (24.0%) (Fig 2).

Table 3: Triggering factors for asthma exacerbations during pregnancy (N = 50)

Triggering factor	n (%)
Smoking exposure	20 (40.0)
Air pollution	20 (40.0)
Cold air	16 (32.0)
Weather changes	15 (30.0)
Exposure to insects and animals	11 (22.0)
Strong smells	11 (22.0)
Viral infections	8 (16.0)
Perfumes	6 (12.0)
Food-related triggers	3 (6.0)
Irritants	2 (4.0)

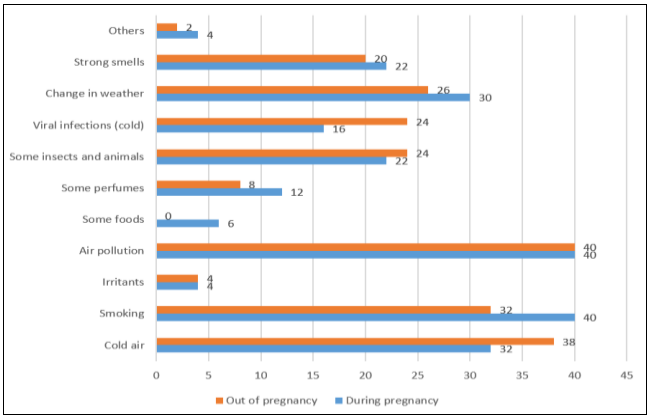

Fig 2: Triggering factors for asthma exacerbations during and outside pregnancy among study participants (N = 50)

Asthma Control and Treatment Patterns

The majority (72.0%) of participants were on regular treatment for asthma and 28.0% were not on regular treatment of asthma. Participants who participated in treatment still had a low rate of well controlled asthma with 22.0%. Partially controlled asthma was noted in 28.0% of participants and uncontrolled asthma was noted in 50.0% of participants (Fig 3).

A majority of participants (54.0%) experienced an increase in asthma symptoms throughout pregnancy, which were worse than the period before their pregnancies. For 40.0% of the participants no differences in symptoms were observed and only 6.0% improved symptoms during pregnancy (Table 4).

Table 4: Asthma symptom control during pregnancy compared with before pregnancy (N = 50)

Symptom control during pregnancy	n (%)
Worse	27 (54.0)
No difference	20 (40.0)
Better	3 (6.0)

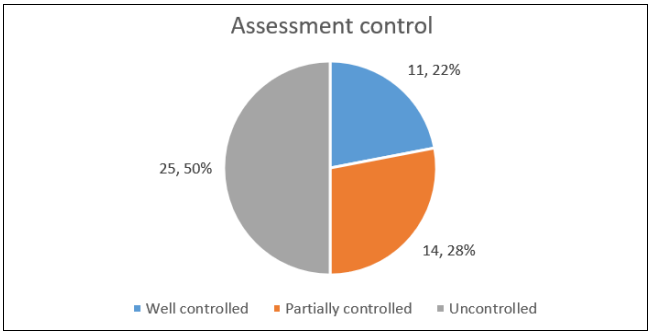

Fig 3: Level of asthma control among pregnant women with asthma during pregnancy (N = 50)

Asthma Severity and Medication Use

Assessment of asthma severity revealed that three fourths of subjects (72.0%) had at least one exacerbation of their asthma during the current pregnancy. In addition, the majority of participants (36.0%) had greater than two exacerbations and an additional 36.0% had one to two exacerbations throughout pregnancy. Only 28.0% reported no exacerbations during the study period.

As for healthcare utilization, 40.0% of the participants needed outpatient care for asthma exacerbations and 18.0% needed admission to the hospital ward and admission to the intensive care unit was reported by one participant (2.0%).

Almost all participants (98.0%) used short acting beta-agonist (SABA) compared to 44.0% who used inhaled corticosteroid (ICS). But, adherence to ICS therapy was low: 18.0% adherence was good; 82.0% adherence was poor.

In terms of SABA use, 58.0% reported using two to three times per day, and 26.0% reported using more than three times per day, demonstrating moderate to severe asthma symptomology in a significant number of participants.

Active smoking Exposure was much less prevalent and reported by 8.0% participants while Passive smoking Exposure reported high prevalence 66.0% (Table 5).

Table 5: Asthma severity, medication use, and risk factors among study participants (N = 50)

Variable	Category	n (%)
Exacerbation during pregnancy	None	14 (28.0)
	1–2 exacerbations	18 (36.0)
	>2 exacerbations	18 (36.0)
Exacerbation management	Outpatient treatment	20 (40.0)
	Ward admission	9 (18.0)
	ICU admission	1 (2.0)
Medication use (SABA)	Yes	49 (98.0)
Medication use (ICS)	Yes	22 (44.0)
ICS adherence	Good adherence	9 (18.0)
	Poor adherence	41 (82.0)
Cigarette exposure	Active smoker	4 (8.0)
	Passive smoker	33 (66.0)
	No exposure	13 (26.0)

Co-morbidities and Pregnancy Outcomes

There were several co-morbid conditions among the subjects of this study. The most common co-morbidities were gastroesophageal reflux disease (GERD; 64.0%) and allergy, with eczema, allergic rhinitis, or rhinosinusitis (58.0%). Thirty percent of the study participants reported drug allergy, 18.0% reported a confirmed food allergy, 8.0% reported obstructive sleep apnea, and 4.0% reported depression or anxiety (Fig 4).

Favourable pregnancy outcomes were seen in 64.0% and poor pregnancy outcomes in 36.0% of those surveyed (Fig 5).

When analysed statistically, there was a significant correlation between maternal age and pregnancy outcomes ($p = 0.042$) and younger patients had better outcomes than the older groups. Likewise, participants with a diagnosis in childhood had significantly better outcomes than newly diagnosed participants ($p = 0.046$).

Poor pregnancy outcomes were statistically associated with depression and anxiety ($p = 0.040$). With other co-morbidities assessed, no statistically significant relations with pregnancy outcome were found (Table 6).

Table 6: Factors associated with pregnancy outcomes among study participants (N = 50)

Variable	Association with poor outcomes	p-value
Older maternal age	Significant association	0.042*
Recent asthma diagnosis	Significant association	0.046*
Depression and anxiety	Significant association	0.040*

Statistically significant at $p < 0.05$.

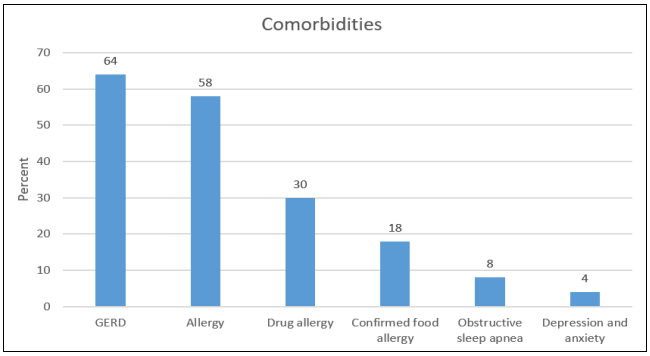

Fig 4: Co-morbidities among pregnant women with asthma included in the study (N = 50)

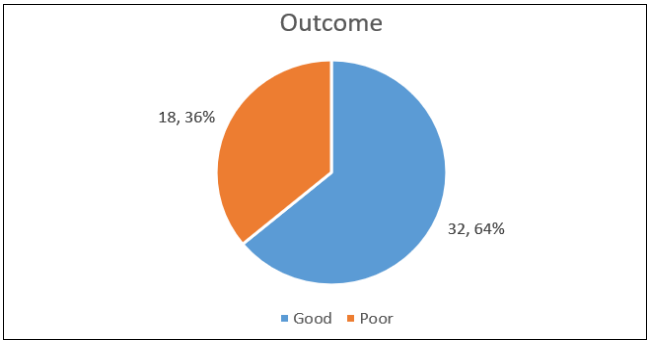

Fig 5: Pregnancy outcomes among pregnant women with asthma included in the study (N = 50)

In summary, the results of this study showed high prevalence of uncontrolled asthma symptoms, high prevalence of asthma exacerbations, low adherence to ICS (inhaled corticosteroid) use, and high probability of having exposure to environmental triggering factors among pregnant women with asthma. Older participants and as well as those who were recently diagnosed, and who had symptoms of depression and anxiety were more likely to have poor outcomes during pregnancy. The results show the clinical burden of pregnancy asthma in the population studied.

Discussion

Asthma is a chronic medical condition that continues to cause a burden for mothers and their unborn child and remains one of the most prevalent chronic disorders of pregnancy globally [14-16]. Physiological, hormonal, and immunological changes in pregnancy can shift the clinical course of asthma, and further exacerbate the woman's asthma symptoms and reduce asthma control and exacerbation risk in susceptible women [17]. The objective of the present study was that asthma symptoms, triggering factors, and the control and severity of asthma as well as pregnancy outcomes amongst pregnant women with asthma attending Kassala Women and Obstetrics Hospital in Sudan were assessed.

This study showed that the most common symptoms of asthma in pregnancy were the presence of shortness of breath, cough, chest tightness and wheezing with shortness of breath being the most common symptom among the participants. Over half of study participants experienced worsening of asthma symptoms during pregnancy, relative to the pre-pregnancy period. These results align with earlier studies of the exacerbation of asthma during pregnancy

associated with the enhanced requirement on oxygenation, the decrease in functional residual capacity, hormonal changes, and different immunological mechanisms during gestation [9, 17]. Likewise, Stevens *et al* (2022) found that there was a decrease in asthma control for a large proportion of pregnant women [18], and Belanger *et al* (2010) showed that symptoms of asthma and use of medications significantly changed during pregnancy [19]. The increased rate of worsening symptoms found in the present study might be attributed to a lack of specialized respiratory care, delayed follow-up and poor adherence to treatment in resource-limited health care environments.

The environmental and behavioral triggers were shown to be important in exacerbating asthma in the participants of the study. The most common triggers reported were smoking exposure and air pollution, followed by the weather, cold air, viral infections and strong odors. Robijn *et al*. (2022), Rey *et al*. (2019) and Ramlal *et al*. (2024) have found smoking exposure, environmental pollutants and respiratory infections are the major factors for triggered asthma in pregnancy [10, 20, 21] and the present study supports their findings. The high prevalence of passive smoking exposure recorded in this study is clinically significant as tobacco smoke exposure is linked to poor asthma control, more exacerbations, poor fetal oxygenation, and adverse pregnancy outcomes [15]. Furthermore, environmental pollution and poor air quality can also be a factor in the chronic airway inflammation and higher burden of respiratory symptoms experienced by pregnant women with asthma, especially in developing countries where the quality of air may not be as good and environmental controls may be less.

Most participants indicated that they received regular asthma treatment, but a large proportion of the study population had poor asthma control. Only half of the participants were had uncontrolled asthma and only a small proportion had the asthma well controlled. Adherence to inhaled corticosteroid was also found to be suboptimal in participants. The results are consistent with previous studies indicating that despite effective treatment options, poorly controlled asthma is common during pregnancy [22, 23]. Poor asthma control during pregnancy is likely to be caused by fear of potential adverse effects on the unborn child, lack of patient education, poor adherence with inhaled corticosteroids and irregular antenatal follow-up [11, 24, 25]. In addition, the high rates of short acting beta agonist use reported in this study indicate that a significant disease burden was not being controlled in the long term among participants. Earlier research has also highlighted the need for guidance during the management of asthma during pregnancy and the importance of taking the controller medicines to minimise maternal and fetal complications [26].

Nearly three-quarters of the current study participants experienced an exacerbation of asthma during pregnancy, indicating that exacerbations are also common during this time period. Over one-third of those taking part reported having suffered two or more exacerbations and a certain percentage needed hospital admission or intensive care management. This is similar to previous studies showing the persistence of exacerbations of asthma in pregnancy and strong associations with poor asthma control and maternal morbidity [9, 27]. In addition, Gu *et al*. (2024) found that women with asthma during pregnancy had more exacerbations [28] and Robijn *et al* (2022) found that poor asthma control, obesity, smoking exposure, and previous exacerbation history were all key drivers of asthma getting worse in pregnancy. Further, the high exacerbation rate seen in our study may point to a lack of appropriate asthma monitoring and support from specialist asthma management services. Furthermore, insufficient knowledge about the safety and significance of controller treatment in pregnancy may play a role in sub-optimal adherence to controller treatment and/or symptom burden in pregnant women with asthma.

Study participants were also likely to have co-morbid conditions, including gastroesophageal reflux disease and allergic conditions, including allergic rhinitis and eczema disease. The participants showed a statistically significant relationship between depression or anxiety and a poor pregnancy outcome. These results agree in part with the previous study showing that maternal psychological disorders can adversely affect asthma control, compliance and quality of life in pregnancy [29]. Psychological stress and anxiety could exacerbate asthma symptoms via neuroendocrine and inflammatory pathways, and could also be associated with poor medication adherence and delayed health care seeking.

The occurrence of poor pregnancy outcome was noted in a significant number of participants in the present study. Old age, recent diagnosis of asthma and depression or anxiety were significantly related with adverse outcomes. These associations have been described in previous studies that found uncontrolled asthma and regular exacerbations during pregnancy to be associated with various potential complications, including low birth weight, preeclampsia, prebirth complications and preterm births [7, 30, 31]. The association of recent diagnosis with poor outcomes seen in this study could be due to under- or misdiagnosis of the disease and failure to provide early and effective management.

The results of the present study emphasize the need for regular asthma assessment and multi-specialty care of the pregnant woman. There is emerging evidence that improved patient education, greater adherence to inhaled corticosteroid therapy, reduced environmental exposure to smoking and pollutants and routine antenatal respiratory follow-up may benefit asthma control and minimize adverse maternal and fetal outcomes in pregnant women with asthma, in line with current, evidence-based recommendations for asthma management during pregnancy [32].

The present study showed that overall uncontrolled asthma symptoms, frequent asthma exacerbations, environmental triggers and poor pregnancy outcomes were very high in pregnant women with asthma in Kassala, Sudan. Participants were often poorly controlled with asthma, not taking inhaled corticosteroid medications and had significant exposure to passive smoking and air pollution. These results emphasise the need for better monitoring of asthma during pregnancy, asthma education and multi-disciplinary management to decrease the asthma in maternal and fetal complications during pregnancy. The results of this study are relevant to the antenatal respiratory care in low-resource areas. Incorporating asthma screening and respiratory assessment into routine prenatal care could enhance the detection, adherence to treatment, and outcomes for maternal health. These results also support the importance of public health measures to reduce smoking

exposure, environmental factors and patient-centered asthma education programs during prenatal care. The results of this study can help to develop specific antenatal asthma management programs in Sudan and other low resource healthcare system.

Conclusion

The present study demonstrated that asthma during pregnancy remains a significant clinical concern among pregnant women attending Kassala Women and Obstetrics Hospital in Kassala, Sudan. The most common symptoms reported were shortness of breath, cough, chest tightness, and wheezing, with over half of the participants reporting worsening of symptoms during pregnancy. Poor asthma control, frequent exacerbations, low adherence to inhaled corticosteroid therapy, and substantial exposure to environmental triggering factors, particularly passive smoking and air pollution, were highly prevalent among participants. The study also found significant links between poor pregnancy outcomes and older maternal age, recent asthma diagnosis and depression and anxiety. The results of this study emphasize the need for early asthma diagnosis, frequent antenatal respiratory evaluation, patient education, ongoing use of controller drugs, and the need for multi-disciplinary management during pregnancy. Increased monitoring of asthma and increased awareness of avoiding triggers and adherence to asthma treatment could help to improve maternal and fetal outcomes in pregnant women with asthma in resource-limited settings like Sudan. More prospective and multicenter studies are recommended with larger populations in order to assess the epidemiology, determinants and long term maternal and fetal outcomes in the context of asthma in pregnancy in low-resource areas in Sudan.

Limitations

One of the strengths of this study is that it provides local clinical evidence regarding asthma during pregnancy in Sudan, where published data remain limited. There are a number of limitations in this study. The study was carried out in one health center and the sample size was limited; this could restrict the generalizability of the findings. Furthermore, the cross-sectional study design does not allow any causal conclusions to be drawn between pregnancy outcomes and the various risk factors. There were some clinical data that participants had to self-report, which can lead to the potential for recall bias.

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