A cross-sectional analysis of lung function in asthmatic and non-asthmatic pregnant women in Baghdad

By Meena Salah Salah Abdulfattah

WORD COUNT 4732
TIME SUBMITTED 24-JUL-2024 06:15PM
PAPER ID 110652949

A cross-sectional analysis of lung function in asthmatic and non-asthmatic pregnant women in Baghdad

Meena Salah Abdulfattah[1], Nada Musaab Abbas[1], Yousif Abdul-Raheem[2], Riyadh Shiltagh Al-Rudaini[1]

[1]Nutrition Research Institute, Public Health Directorate, Ministry of Health, Baghdad, Iraq
[2]Community and Family Medicine Department, Al Kindy College of Medicine, Ministry of Higher Education, Baghdad, Iraq

Corresponding author:
Riyadh Shiltagh Al-Rudaini
E-mail: riyadhalrudaini88@gmail.com

Abstract

Background: Pregnancy can cause variable changes in breathing, with shortness of breath being common. This study investigates how lung function changes in pregnant women, including those with asthma, a prevalent respiratory disease that can worsen during pregnancy. We use spirometry to assess lung function and see how factors like age, weight, and smoking habits might influence their breathing health. We also aim to understand if asthma is underdiagnosed in pregnancy and how it can impact both mothers and babies.

Methods: A cross-sectional design was used to investigate lung function in pregnant women with and without asthma. Researchers recruited 200 women (18- 35 years old) attending maternity and respiratory clinics during the study period, excluding those with pre-existing health conditions. They used questionnaires, weight and height measurements, and spirometry testing (lung function test) to assess pulmonary health at a single point in time.

Results: A significant proportion had abnormal Forced Expiratory Volume in one second (FEV1), indicating potential airflow limitation. The Forced Vital Capacity (FVC), indicating a reduced ability to fully inhale and exhale air, was also abnormal in a substantial majority. Most concerning was the high prevalence of abnormal FEV1/FVC ratio, a key indicator of airway obstruction, even in some participants with normal FEV1 and FVC values individually. Asthmatic pregnant women had a significantly lower prevalence of normal FEV1 and a higher prevalence of abnormal FEV1/FVC ratio compared to non-asthmatic women. This suggests a higher prevalence of airflow limitation in the asthmatic group.

Recommendations: The study highlights the importance of routine lung function testing during pregnancy, particularly for asthmatic women. Early identification and optimal management of asthma are crucial for ensuring the well-being of both mother and baby. Additionally, further research is needed to explore the impact of factors like obesity, gastro-esophageal reflux disease, and passive smoking on lung function in pregnant women.

Keywords: Asthma, Pregnancy, Pulmonary function, Baghdad.

INTRODUCTION

Pregnancy is a dynamic physiological state characterized by variable changes in the respiratory system [1]. While dyspnea (shortness of breath) and other respiratory symptoms are frequent during gestation, particularly in the later trimesters [2], the impact on pulmonary function remains a topic of investigation. Notably, asthma, a prevalent chronic respiratory disease [3], poses a significant health concern for pregnant women. Estimates suggest that 3-8% of expecting mothers have asthma, and uncontrolled asthma can lead to adverse maternal and perinatal outcomes, including preeclampsia, low birth weight, and preterm delivery [4].

Despite the potential complications associated with uncontrolled asthma during pregnancy, existing guidelines on high-risk pregnancies often overlook this condition [5]. This is concerning, as early identification and optimal management of asthma in pregnancy are crucial for ensuring the well-being of both mother and baby [6].

While the precise mechanisms underlying changes in pulmonary function during pregnancy, both in healthy women and those with asthma, are not fully elucidated [7], meticulous monitoring throughout gestation is essential to prevent asthma exacerbations and associated complications [8]. Spirometry, a well-established tool for diagnosing and monitoring asthma, offers a valuable approach to objective assessment of lung function in this population [9].

However, studies suggest a concerning lack of awareness among healthcare providers regarding the importance of asthma control in pregnancy, coupled with anxieties about medication use during this critical period [10]. This highlights the need for improved education and standardized practices to ensure optimal care for asthmatic pregnant women.

This study investigates the underdiagnoses of asthma in pregnancy and its potential impact on both mothers and babies. We will utilize spirometry, an objective lung function test, to assess asthmatic pregnant women and explore how factors like age, weight, and smoking habits might influence their pulmonary health. This research is crucial because asthma is common among women of childbearing age, and uncontrolled asthma during pregnancy can lead to complications for newborns, highlighting the need for improved asthma management within comprehensive prenatal care.

OBJECTIVES

1. Assess the prevalence of abnormal spirometry results among asthmatic pregnant women.
2. Evaluate pulmonary function in a control group of non-asthmatic pregnant women.
3. Compare the rates of smoking, obesity, and gastroesophageal reflux disease (GERD) between asthmatic and non-asthmatic pregnant women.
4. Investigate the association between abnormal spirometry and factors such as age, body mass index (BMI), smoking status, and presence of GERD.

METHODS

Study design

A cross-sectional design was adopted to assess the pulmonary function of pregnant women at a single point in time. This design allowed for the comparison of lung function parameters between asthmatic and non-asthmatic pregnant women attending the maternity care consultation clinic and the respiratory outpatient clinic.

Study setting

The study was conducted at Baghdad Teaching Hospital within the Medical City complex. Specifically, data collection occurred at the Obstetrics and Gynecology Department's maternity care consultant clinic and the Respiratory Outpatient Clinic. These locations were chosen due to their accessibility and availability of necessary equipment for sample collection.

Study population

This study recruited pregnant women aged 18-35 who provided written informed consent. To ensure accurate categorization, asthmatic women had to have a physician diagnosis of asthma at least six months before the study, while non-asthmatic women could not have any history of such a diagnosis. Additionally, women with known anemia, pneumonia, systemic illness, pregnancy-induced hypertension, diabetes, or cardiovascular or respiratory illness were excluded from participation.

Sample size

A total of 200 pregnant women were recruited during the study period (July 2021 to July 2022). Participants were recruited from those attending the maternity care consultation clinic in collaboration with the respiratory outpatient clinic. The COVID-19 pandemic limited participant recruitment due to the increased workload in public health centers focused on epidemiological investigation and vaccination efforts. Asthmatic status was determined based on self-reported physician diagnosis of asthma at any point in the participant's life.

Data collection tools

Data to assess pulmonary function in pregnant women was collected through a researcher-administered questionnaire covering demographics, medical history, and factors like GERD and smoking. Weight, height, and BMI were measured using a standardized scale. Lung function was evaluated with an SP100 Digital Spirometer; with participants performing maneuvers three times to obtain the best value. Following informed consent and medical history screening, the questionnaire was completed, anthropometric measures were taken, lung function tested, and data was collected from eligible participants. For asthmatic women, confirmation of physician diagnosis at least six months prior and established treatment plans were ensured.

Data collection procedures

Data collection occurred during working hours at both participating clinics. After obtaining written informed consent from each participant, a detailed medical history was recorded to rule out exclusion criteria. The researcher-administered questionnaire was then completed, followed by weight and height measurements. Subsequently, lung function testing was conducted using the SP100 Digital Spirometer. Pregnant women, both asthmatic and non-asthmatic, were selected from

those attending antenatal checkups and meeting the inclusion criteria. Asthmatic participants were confirmed to have a previous physician diagnosis of asthma at least six months before the study and have established treatment plans.

Statistical analysis

Descriptive statistics were used to summarize participant characteristics. Chi-square tests were employed to assess associations between categorical variables, while t-tests were used to compare continuous variables between asthmatic and non-asthmatic groups. Analysis of variance (ANOVA) tests were utilized to explore differences among groups with more than two categories. Results were considered statistically significant if the p-value was less than 0.05.

Official and ethical approvals

The research proposal received ethical approval from the Arab Board Scientific and Ethical Committee. Additionally, approvals were obtained from the Iraqi Ministry of Health (Baghdad Al-Rusafa) and the hospital administration. Written informed consent was obtained from all participants using an Arabic-language document that explained the study aims, ensured participant confidentiality, and outlined the potential consequences of information collection.

Data availability: Due to privacy concerns, individual participant data cannot be publicly shared.

Financial support: The study was funded solely by the researcher and did not receive financial support from any institutions or organizations.

RESULTS

Table 1 revealed that the study sample (N=200) consisted primarily of young adults, with 68% of participants falling between 18-29 years old. The majority of the women (48%) were classified as obese, followed by overweight (32%) and normal weight (20%) categories. Notably, 85% of participants were non-smokers, with the remaining 15% exposed to secondhand smoke. This suggests a relatively low prevalence of active smoking within the sample. In terms of pregnancy history, a higher proportion of women (71.5%) were multigravida (having been pregnant before) compared to primigravida (first pregnancy). Additionally, the distribution of trimesters skewed slightly towards the third trimester (62.5%), with 37.5% in the second trimester. Interestingly, nearly half of the participants (45%) reported experiencing GERD.

Also, **table 1** presents the baseline characteristics of the 200 pregnant women enrolled in the study, divided into asthmatic and non-asthmatic groups. Age distribution was similar between groups (p=0.762). BMI showed a trend towards a higher prevalence of overweight and obesity in the asthmatic group (p=0.121), although not statistically significant. Smoking rates were low overall (85% non-smokers), with no significant difference between groups (p=0.428). GERD was significantly more prevalent among asthmatic women (p=0.047), suggesting a potential

association between asthma and GERD in pregnancy. Gravidity (first or subsequent pregnancy) was evenly distributed (p=0.631). However, a significant difference emerged in the trimester distribution (p=0.001). The majority (73.3%) of non-asthmatic women were in their second trimester, compared to only 26.7% of asthmatic women. Conversely, a larger proportion of asthmatic women (64%) were in their third trimester compared to non-asthmatic women (36%).

Table 1: Study sample characteristics divided into asthmatic and non-asthmatic groups

Variables	Non asthmatic (N=100)		Asthmatic (N=100)		Total (N=200)		P-value
	Freq.	%	Freq.	%	Freq.	%	
Age							
18-29	67	49.3	69	50.7	136	68.0	0.762
30-35	33	51.6	31	48.4	64	32.0	
BMI							
Normal	25	62.5	15	37.5	40	20.0	0.131
Overweight	33	51.6	31	48.4	64	32.0	
Obese	42	43.8	54	56.2	96	48.0	
Smoking							
Nonsmoker	83	48.8	87	51.2	170	85.0	0.428
Passive smoker	17	56.7	13	43.3	30	15.0	
GERD							
Yes	30	42.2	52	57.8	90	45.0	**0.047**
No	62	56.4	48	43.6	110	55.0	
Gravidity							
Primigravida	30	52.6	27	47.4	57	28.5	0.631
Multigravida	70	49.0	73	51.0	143	71.5	
Trimester							
Second	55	73.3	45	26.7	75	37.5	**0.001**
Third	45	36.0	80	64.0	125	62.5	

Table 2 highlights findings regarding lung function in the study population. Notably, a significant proportion of participants demonstrated abnormal results across all three lung function parameters measured. Over two-thirds (69.5%) had abnormal FEV1, indicating potential airflow limitation. Similarly, a substantial majority (73.5%) exhibited abnormal FVC, suggesting a reduced ability to fully inhale and exhale air. However, the most concerning finding is the high prevalence (10.5%) of abnormal FEV1/FVC ratio, a key indicator of airway obstruction. This suggests that a significant number of participants, even those with normal FEV1 and FVC values individually, may have underlying respiratory issues.

Also, **table 2** presents the pulmonary function test results stratified by asthmatic and non-asthmatic groups. A significant difference (p=0.004) was observed in FEV1. Non-asthmatic women

displayed a higher prevalence of normal FEV1 (65.6%) compared to asthmatic women (34.4%). Conversely, abnormal FEV1 was more frequent in the asthmatic group (56.8%) compared to the non-asthmatic group (43.2%). No statistically significant difference (p=0.4) was found in FVC between the groups, with normal FVC observed in a similar proportion of asthmatic and non-asthmatic participants (around 50%). However, the FEV1/FVC ratio, a key indicator of airflow limitation, revealed a significant difference (p=0.001). A considerably higher percentage of non-asthmatic women had a normal FEV1/FVC ratio (55.3%) compared to asthmatics (44.7%). Conversely, abnormal FEV1/FVC ratio, suggestive of airflow obstruction, was predominantly observed in the asthmatic group (95.2%) compared to non-asthmatic women (4.8%). These findings suggest that asthmatic pregnant women in this study had a higher prevalence of airflow limitation as evidenced by abnormal FEV1 and FEV1/FVC ratio.

Table 2: Pulmonary function test results divided into asthmatic and non-asthmatic groups

Pulmonary function test	Non asthmatic (N=100)		Asthmatic (N=100)		Total (N=200)		P-value
	Freq.	%	Freq.	%	Freq.	%	
FEV1							
Normal FEV1	40	65.6	21	34.4	61	30.5	**0.004**
Abnormal FEV1	60	43.2	79	56.8	139	69.5	
FVC							
Normal FVC	24	45.3	29	54.7	53	26.5	0.4
Abnormal FVC	76	51.7	71	46.3	147	73.5	
FEV1/FVC ratio							
Normal FEV1/FVC ratio	99	55.3	80	44.7	179	89.5	**0.001**
Abnormal FEV1/FVC ratio	1	4.8	20	95.2	21	10.5	

Table 3 summarizes the characteristics of the study participants and their lung function test results. There were no significant differences in lung function (FEV1, FVC, FEV1/FVC ratio) based on age group (18-29 vs. 30-35). Similarly, gravidity (primi vs. multi) did not significantly impact lung function, though there was a trend towards lower FEV1 predicted % in multigravid women (p=0.08). Interestingly, passive smoking showed a trend towards a higher FEV1/FVC ratio (p=0.06) and FEV1 predicted % (p=0.01) compared to non-smokers. However, the presence of GERD was associated with significantly lower FEV1 (p=0.001), FVC (p=0.001), and FEV1 predicted % (p=0.001) compared to those without GERD. Gestational age had a clear influence, with participants in the second trimester demonstrating significantly higher lung function measures (FEV1, FEV1/FVC) and predicted values (FEV1%, FVC%) compared to the third trimester (all p-values <0.01). Finally, overweight and obese participants had lower lung function measures

(FEV1, FVC, FEV1 predicted %) compared to those with normal BMI, with significant differences observed for FEV1 predicted % (p=0.01) and BMI (p=0.01).

Table 3: Characteristics of the study sample and pulmonary function test results

Variables	Mean ± SD of the pulmonary function test results				
	FEV1	FVC	FEV1/FVC Ratio	FEV1 predicted %	FVC predicted %
Age					
18-29	1.97±0.5	2.41±0.5	79.97±12.5	70.84±17.6	76.16±15.5
30-35	2±0.5	2.48±0.5	80.66±11.9	73.83±16.8	74.9±13.9
P value	0.5	0.2	0.6	0.4	0.1
Gravidity					
Primi	1.89±0.5	2.35±0.4	75.69±11.9	69.98±14.7	75.29±13.2
Multi	1.95±0.5	2.37±0.4	81.35±12.7	71.99±18.5	71.85±15.7
P value	0.8	0.5	0.9	0.6	0.08
Smoking					
Nonsmoker	2.23±0.5	2.73±0.5	83.45±12.8	70.86±16.99	75.971±4.9
Passive smoker	2.12±0.8	2.71±0.7	86.45±11.1	76.44±18.4	74.65±15
P value	0.3	0.7	0.06	**0.01**	0.7
GERD					
No	2.35±0.5	2.8±0.8	84.2±13.2	75.47±17.5	76.15±14.7
Yes	2±0.46	2.6±0.6	83.65±11.5	66.47±15.7	75.17±15.3
P value	**0.00**	**0.00**	**0.02**	**0.00**	0.5
Gestational age					
2nd trimester	2.48±0.4	2.43±0.4	81.28±13.5	76.55±17.04	74.76±14.5
3rd trimester	1.79±0.4	2.37±0.4	79.49±12.4	65.74±15.25	72.39±15.9
P value	**0.00**	0.1	0.6	**0.00**	**0.00**
BMI					
Overweight	2±0.5	2.39±0.5	81.24±12.4	68.6±16.7	76.1±15
Obese	1.92±0.55	2.4±0.5	79.03±12	72.08±17.78	74.33±14.6
P value	**0.02**	**0.01**	0.2	**0.01**	0.1

Table 4 presents the results of a logistic regression analysis investigating factors associated with abnormal FEV1% assessment in pregnant women. The analysis revealed that asthma (β = 1.484, p = 0.000, OR = 4.410) was the strongest predictor of abnormal FEV1%, with asthmatic women having 4.41 times greater odds of having an abnormal result compared to non-asthmatic women. Additionally, the pregnancy stage played a significant role. While the coefficient for the second trimester was not significant (β = 0.011, p > 0.05), being in the third trimester (β = 0.907, p = 0.011, OR = 2.477) increased the odds of abnormal FEV1% by 2.477 times compared to the first

trimester. Interestingly, obesity (β = 0.773, p = 0.007, OR = 2.166) also emerged as a significant predictor, with obese women having 2.166 times higher odds of abnormal FEV1% compared to normal-weight women. Finally, GERD (Gastro-esophageal Reflux Disease) (β = 0.937, p = 0.000, OR = 2.552) was associated with an increased likelihood of abnormal FEV1%, with women experiencing GERD having 2.552 times greater odds of an abnormal result compared to those without GERD. These findings suggest that a combination of factors, including asthma, pregnancy stage (specifically the third trimester), obesity, and GERD, contributes to the risk of abnormal lung function as measured by FEV1% in pregnant women.

Table 4: logistic regression analysis investigating factors associated with abnormal FEV1% assessment

	B	S.E.	P value	Odd's ratio
Asthma	1.484	0.246	**0.000**	4.410
Normal BMI			**0.019**	
Overweight	0.109	0.291	0.708	1.115
Obesity	0.773	0.284	**0.007**	2.166
GERD	0.937	0.251	**0.000**	2.552
Second trimester			**0.011**	
Third trimester	0.907	0.355	**0.011**	2.477

DISCUSSION

This study investigated pulmonary function test parameters among asthmatic and non-asthmatic pregnant women. The discussion section delves into the findings, comparing them with existing research and highlighting areas for further exploration.

Age and additional factors

The similar age distribution between the groups ensures that age-related differences don't confound the interpretation of lung function variations. This aligns with the findings of Amare YE and Haile D [11]. The study identifies a high prevalence of obesity and GERD in the overall sample. This aligns with an Iraqi study reporting a 33.9% obesity rate in women [12, 13]. The observed association between GERD and asthma in pregnant women is consistent with previous research suggesting progesterone-induced relaxation of the esophageal sphincter, leading to reflux and potentially worsening asthma symptoms [14, 15, 16].

Impact of pregnancy on lung function

Despite extensive research on pulmonary function in pregnancy, spirometry results remain controversial. Some studies report increased FEV1 and FVC, particularly in the third trimester [17], while others observe no change [18]. This study found a high prevalence of abnormal FEV1 levels, potentially explained by:

- The growing uterus displaces the diaphragm, limiting lung expansion and hindering forceful expiration, leading to lower FEV1.
- Elevated estrogen levels may increase airway mucus, and rising prostaglandins can increase airway resistance and bronchial smooth muscle constriction [19].

Asthma and pulmonary function

The lower pulmonary functions observed in asthmatic pregnant women align with previous research demonstrating decreased FEV1 and FEV1% in this group [11]. This could be due to underlying asthmatic airway inflammation leading to obstruction and air trapping in the lungs [20]. Pregnancy effects on asthma vary. A large study reported one-third of patients experiencing improvement, one-third worsening, and one-third no change [21].

FVC and FEV1/FVC ratio

Unlike some studies reporting increased FEV1 and FVC during pregnancy [22, 23], this study found no significant differences in FVC between asthmatic and non-asthmatic pregnant women. This aligns with research suggesting unchanged total lung capacity and vital capacity despite a 30-50% increase in minute ventilation (mainly due to a 40% rise in tidal volume) [24]. The FVC remains stable as the increase in inspiratory capacity is offset by a decrease in expiratory reserved volume (ERV). However, reduced ERV can contribute to lower FVC levels in pregnancy [25]. The observed significant difference in FEV1/FVC ratio between asthmatic and non-asthmatic pregnant women aligns with findings from previous studies [26, 27]. However, it contradicts research by [28] who found no such difference in the second trimester.

Socioeconomic status and obesity

The study highlights the potential impact of socioeconomic status on lung function. Poor nutrition in lower-middle-class and low-income pregnant women can hinder muscle and lung development, leading to decreased pulmonary function [29].

The analysis reveals a significant effect of obesity on FEV1, FVC, and FEV1% predicted value in asthmatic pregnant women. This aligns with research by [30] suggesting obesity is associated with exertional dyspnea and potentially refractory asthma. The logistic regression finding supports this, indicating obesity increases the likelihood of abnormal FEV1%. Obesity might also contribute to abnormal peripheral lung function [31].

Unlike studies observing increased FEV1, FVC, and their ratio with higher gravidity [32, 33], this study found no significant differences between primigravida and multigravida women. This contradicts the interpretation of these studies suggesting progressive relaxation leads to improved lung function in higher parity. However, another study by [34] reported a reduced FEV1/FVC ratio in nulliparous compared to multiparous women. The study by [21] recommends additional monitoring for multigravida with moderate or severe asthma.

Passive smoking and gestational age

The finding of significantly lower FEV1% among passive smokers aligns with evidence that passive smoking reduces lung function [22] and increases the risk of chronic obstructive pulmonary disease [35]. This might be due to airway narrowing and increased airway resistance [36]. However, some studies haven't shown similar effects [36]. The lower prevalence of passive smoking among asthmatic pregnant women might be due to increased awareness about the risks of maternal smoking on lung function.

CONCLUSIONS

Researchers examined lung function in pregnant women with and without asthma. They found a surprising number of women, in both groups, had abnormal lung function, especially when measured using a test called FEV1. Several factors seemed to play a role in this. Women with asthma had worse FEV1 scores and a higher chance of an abnormal FEV1/FVC ratio compared to those without asthma. As the pregnancy progressed into the third trimester, lung function measurements (FEV1, FEV1/FVC) and predicted values (FEV1%, FVC%) all dropped. Additionally, overweight and obese women had lower lung function scores (FEV1, FVC, FEV1 predicted %) compared to those with normal weight. Finally, women with GERD also had significantly lower FEV1, FVC, and FEV1 predicted %. These findings suggest that healthcare providers should monitor lung function throughout pregnancy, particularly for women with asthma, those in the third trimester, overweight or obese women, and women with GERD. More research is needed to understand exactly how these factors affect lung function during pregnancy.

Acknowledgments:

The authors sincerely thank the staff of Baghdad Teaching Hospital's Obstetrics & Gynecology (maternity care) and Respiratory Outpatient Clinics. Their cooperation was vital. The OB/GYN staff facilitated recruitment by allowing access to pregnant women, while the Respiratory Clinic provided equipment for efficient data collection. We are also incredibly grateful to the 200 pregnant women who volunteered. Their participation made this research possible.

Conflict of Interest:

The authors report no relevant financial or non-financial conflicts of interest regarding the publication of this article.

Financial Support:

This study was funded solely by the researcher and did not receive financial support from any institutions or organizations.

References

1. Joshi PK, Chitale MS. A comparative study of arterial oxygen saturation in pregnant and non-pregnant women. Natl J Physiol Pharm Pharmacol. 2017;7(10):1081–3. Available from: https://www.njppp.com/fulltext/28-1495164058.pdf?1720628979
2. de Araujo GV, Leite DF, Rizzo JA, Sarinho ES. Asthma in pregnancy: association between the Asthma Control Test and the Global Initiative for Asthma classification and comparisons with spirometry. Eur J Obstet Gynecol Reprod Biol. 2016 Aug;203:25-9. doi: 10.1016/j.ejogrb.2016.05.010. Available from: https://pubmed.ncbi.nlm.nih.gov/27236601/
3. Jensen D, Duffin J, Lam YM, Webb KA, Simpson JA, Davies GA, Wolfe LA, O'Donnell DE. Physiological mechanisms of hyperventilation during human pregnancy. Respir Physiol Neurobiol. 2008 Mar 20;161(1):76-86. doi: 10.1016/j.resp.2008.01.001. Available from: https://pubmed.ncbi.nlm.nih.gov/18289946/
4. Murphy VE. Managing asthma in pregnancy. Breathe (Sheff). 2015 Dec;11(4):258-67. doi: 10.1183/20734735.007915. PMID: 27066119 Available from: https://pmc/articles/PMC4818212/
5. Moradi-Lakeh, M., El Bcheraoui, C., Daoud, F. et al. Prevalence of asthma in Saudi adults: findings from a national household survey, 2013. BMC Pulm Med 15, 77 (2015). doi.org/10.1186/s12890-015-0080-5. Available from: https://bmcpulmmed.biomedcentral.com/articles/10.1186/s12890-015-0080-5#citeas
6. Vatti RR, Teuber SS. Asthma and pregnancy. Clin Rev Allergy Immunol. 2012 Aug;43(1-2):45-56. doi: 10.1007/s12016-011-8277-8. Available from: https://pubmed.ncbi.nlm.nih.gov/21858482/
7. Murphy VE, Jensen ME, Robijn AL, Wright TK, Mattes J, Collison A, Gibson PG. How Maternal BMI Modifies the Impact of Personalized Asthma Management in Pregnancy. J Allergy Clin Immunol Pract. 2020 Jan;8(1):219-228.e3. doi: 10.1016/j.jaip.2019.06.033. Available from: https://pubmed.ncbi.nlm.nih.gov/31299352/
8. Omorogiuwa, A. and Vincent I. Iyawe. "Effect of parity on FVC and FEV1 during pregnancy." British journal of medicine and medical research. 2015;9(8):1–9. Available from: https://www.semanticscholar.org/paper/Effect-of-parity-on-FVC-and-FEV1-during-pregnancy.-Omorogiuwa-Iyawe/9a53cec95afd79e50791357c0d3300405259c23e
9. Zacharasiewicz A. Maternal smoking in pregnancy and its influence on childhood asthma. openres [Internet]. 2016;2(3):00042-2016. Available from: https://openres.ersjournals.com/content/2/3/00042-2016
10. Dombrowski MP, Schatz M, Wise R, et al. National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network and the National Heart, Lung, and Blood Institute. Asthma during pregnancy. Obstet Gynecol. 2004 Jan;103(1):5-12. doi: 10.1097/01.AOG.0000103994.75162.16. Available from: https://pubmed.ncbi.nlm.nih.gov/14704237/
11. Amare YE, Haile D. Evaluation of Pulmonary Function Tests Among Pregnant Women of Different Trimesters in Debre Berhan Referral Hospital, Shoa, Ethiopia. Int J Womens Health. 2020 Dec 7;12:1135-1143. doi: 10.2147/IJWH.S275742. Available from: https://pubmed.ncbi.nlm.nih.gov/33324115/
12. Pengpid S, Peltzer K. Overweight and Obesity among Adults in Iraq: Prevalence and Correlates from a National Survey in 2015. Int J Environ Res Public Health. 2021 Apr 15;18(8):4198. doi: 10.3390/ijerph18084198. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8071354/
13. Al-Tawil NG, Abdulla MM, Abdul Ameer AJ. Prevalence of and factors associated with overweight and obesity among a group of Iraqi women. East Mediterr Health J. 2007 Mar-Apr;13(2):420-9. PMID: 17684862. Available from: https://pubmed.ncbi.nlm.nih.gov/17684862/
14. Ali Z, Ulrik CS. Obesity and asthma: a coincidence or a causal relationship? A systematic review. Respir Med. 2013 Sep;107(9):1287-300. doi: 10.1016/j.rmed.2013.03.019. Epub 2013 May 1. PMID: 23642708. Available from: https://pubmed.ncbi.nlm.nih.gov/23642708/
15. Chang P, Friedenberg F. Obesity and GERD. Gastroenterol Clin North Am. 2014 Mar;43(1):161-73. doi: 10.1016/j.gtc.2013.11.009. Epub 2013 Dec 27. PMID: 24503366; PMCID: PMC3920303. Available from: https://pubmed.ncbi.nlm.nih.gov/24503366/

16. Fill Malfertheiner S, Malfertheiner MV, Kropf S, et al. A prospective longitudinal cohort study: evolution of GERD symptoms during the course of pregnancy. BMC Gastroenterol. (2011); 12(1):131. Available from: http://www.biomedcentral.com/1471-230X/12/131
17. Grindheim G, Toska K, Estensen ME, Rosseland LA. Changes in pulmonary function during pregnancy: A longitudinal cohort study. BJOG An Int J Obstet Gynaecol. 2012 Jan;119(1):94–101. Available from: http://doi.wiley.com/10.1111/j.1471-0528.2011.03158.x
18. Gluck JC. The change of asthma course during pregnancy. Clin Rev Allergy Immunol. 2004 Jun;26(3):171-80. doi: 10.1385/CRIAI:26:3:171. PMID: 15208463. Available from: https://pubmed.ncbi.nlm.nih.gov/15208463/
19. Kondracki AJ. Prevalence and patterns of cigarette smoking before and during early and late pregnancy according to maternal characteristics: the first national data based on the 2003 birth certificate revision, United States, 2016. Reprod Health. 2019 Sep 13;16(1):142. doi: 10.1186/s12978-019-0807-5. Available from: https://reproductive-health-journal.biomedcentral.com/articles/10.1186/s12978-019-0807-5
20. Annamraju H, Mackillop L. Respiratory disease in pregnancy. Obstet Gynaecol Reprod Med [Internet]. 2017;27(4):105–11. doi.org/10.1016/j.ogrm.2017.01.011. Available from: https://www.obstetrics-gynaecology-journal.com/article/S1751-7214(17)30023-4/abstract
21. Popa M, Peltecu G, Gica N, Ciobanu AM, et al. Asthma in Pregnancy. Review of Current Literature and Recommendations. Maedica (Bucur). 2021 Mar;16(1):80-87. doi: 10.26574/maedica.2020.16.1.80. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8224723/
22. Pastro LDM, Lemos M, Fernandes FLA, Saldiva SRDM, et al. Longitudinal study of lung function in pregnant women: Influence of parity and smoking. Clinics (Sao Paulo). 2017 Oct;72(10):595-599. doi: 10.6061/clinics/2017(10)02. Available from: https://pubmed.ncbi.nlm.nih.gov/29160421/
23. Grindheim G, Toska K, Estensen ME, Rosseland LA. Changes in pulmonary function during pregnancy: a longitudinal cohort study. BJOG. 2012 Jan;119(1):94-101. doi: 10.1111/j.1471-0528.2011.03158.x. Available from: https://pubmed.ncbi.nlm.nih.gov/22004272/
24. Wang H, Li N, Huang H. Asthma in Pregnancy: Pathophysiology, Diagnosis, Whole-Course Management, and Medication Safety. Can Respir J. 2020 Feb 22;2020:9046842. doi: 10.1155/2020/9046842. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7060439/
25. Hoesterey D, Das N, Janssens W, Buhr RG, et al. Spirometric indices of early airflow impairment in individuals at risk of developing COPD: Spirometry beyond FEV1/FVC. Respir Med. 2019 Sep;156:58-68. doi: 10.1016/j.rmed.2019.08.004. Available from: https://pubmed.ncbi.nlm.nih.gov/31437649/
26. Gómez Real F, Burgess JA, Villani S, Dratva J, et al. Maternal age at delivery, lung function and asthma in offspring: a population-based survey. Eur Respir J. 2018 Jun 7;51(6):1601611. doi: 10.1183/13993003.01611-2016. Available from: https://pubmed.ncbi.nlm.nih.gov/29880541/
27. Batool S, Shakoor R, Mustafa G, Anwer A, et al. Comparison of Lung Functions of Pregnant Women With Non-Pregnant Women At Sheikh Zayed Hospital, Rahim Yar Khan. 2012;2(1):1–4. Available from: https://www.semanticscholar.org/paper/COMPARISON-OF-LUNG-FUNCTIONS-OF-PREGNANT-WOMEN-WITH-Batool-Shakoor/e963112badd489ae4d51eaaa0f2d25a1574100ef
28. Sunyal DK, Amin MR, Yasmin A, et al. Study of Forced Expiratory Volume in First Second (FEV1) and Ratio of Forced Expiratory Volume in First Second and Forced Vital Capacity in Percentage (FEV1/FVC%) in Pregnant Women. J Enam Med Coll. 2012;2(1):29–32. DOI: https://doi.org/10.3329/jemc.v2i1.11926. Available from: https://www.banglajol.info/index.php/JEMC/article/view/11926
29. Hoesterey D, Das N, Janssens W, Buhr RG, Martinez FJ, Cooper CB, Tashkin DP, Barjaktarevic I. Spirometric indices of early airflow impairment in individuals at risk of developing COPD: Spirometry beyond FEV1/FVC. Respir Med. 2019 Sep;156:58-68. doi: 10.1016/j.rmed.2019.08.004. Available from: https://pubmed.ncbi.nlm.nih.gov/31437649/
30. Papi A, Brightling C, Pedersen SE, Reddel HK. Asthma. Lancet. 2018 Feb 24;391(10122):783-800. doi: 10.1016/S0140-6736(17)33311-1. . Available from: https://pubmed.ncbi.nlm.nih.gov/29273246/

31. Al-Alwan A, Bates JH, Chapman DG, Kaminsky DA, DeSarno MJ, Irvin CG, Dixon AE. The nonallergic asthma of obesity. A matter of distal lung compliance. Am J Respir Crit Care Med. 2014 Jun 15;189(12):1494-502. doi: 10.1164/rccm.201401-0178OC. Available from: https://pubmed.ncbi.nlm.nih.gov/24821412/
32. Omorogiuwa A, Iyawe VI. Effect of Parity on FVC and FEV1 during Pregnancy. Br J Med Med Res. 2015; 9(8):1–9. Available from: https://pesquisa.bvsalud.org/portal/resource/pt/sea-181034
33. Grindheim G, Toska K, Estensen ME, Rosseland LA. Changes in pulmonary function during pregnancy: a longitudinal cohort study. BJOG. 2012 Jan;119(1):94-101. doi: 10.1111/j.1471-0528.2011.03158.x. . Available from: https://pubmed.ncbi.nlm.nih.gov/22004272/
34. Pastro LDM, Lemos M, Fernandes FLA, et al. Longitudinal study of lung function in pregnant women: Influence of parity and smoking. Clinics (Sao Paulo). 2017 Oct;72(10):595-599. Doi: 10.6061/clinics/2017(10)02. Available from: https://pubmed.ncbi.nlm.nih.gov/29160421/
35. Zubair T, Abbasi A, Khan OA, Amer E. Role of passive smoking in non-smoking related chronic obstructive pulmonary disease. J Pak Med Assoc. 2018 Sep;68(9):1310-1315. PMID: 30317256. Available from: https://pubmed.ncbi.nlm.nih.gov/30317256/
36. Abdulrahman WF. Effect of smoking on peak expiratory flow rate in Tikrit University. Tikrit Med J. 2011;17(1):11–18. Available from: https://iasj.net/iasj/download/f555d852c3917fbe.