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ORIGINAL PAPER

Headache Characteristics in a Sample of Pregnant Iranian Women with Primary Headache

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Abstract

Headache is a common symptom during pregnancy that requires special attention due to the associated potential risks of life-threatening conditions. The aim of this study was to investigate headache characteristics in pregnant women. This study included pregnant women who presented to the antenatal outpatient clinic with a chief complaint of headache between February 2022 and July 2023. Eligible participants were recruited. Patients with high-risk pregnancies, fetal complications, postpartum headaches, smoking or opiate use, age less than 18 years, or pathological headaches were excluded from the study. The instruments used included a demographic form that collected information on headache history, the International Headache Society (IHS) criteria, and a visual analog scale. A total of 400 pregnant women with headache were selected. The mean age was 27.3 ± 5.06 years, mean gestational age was 32.2 ± 6.05 weeks, and parity was 2 ± 0.70. Multivariate analysis showed that age and gestational age were significantly associated with an increased incidence of migraine without aura and that a history of headache was significantly associated with the occurrence of tension headache. In addition, headache before pregnancy had a significant impact on headache intensity during pregnancy. We observed a significant interaction effect between time and headache type and a significant effect on headache intensity between headache types over time. These findings contribute to a better understanding of headache in pregnancy and emphasize the importance of tailored treatment strategies for pregnant women suffering from these symptoms, especially in emergency situations.

Keywords Migraine · Pregnancy · Headache · Primary headache

Introduction

Headaches are a common issue among women of reproductive age and vary with hormonal changes and stages of life [1]. The most frequently observed headaches in this age group were tension-type headaches (TTH) and migraine. Tension-type headaches occur 1.5 times more often in women than in men [2]. Additionally, some patients may experience worsened headaches during menstruation, pregnancy, and menopause [3, 4].

Previous research suggests a link between headaches and female hormones, particularly estrogen [5]. This link is particularly evident during pregnancy, a time characterized by significant physiological changes, including hormonal shifts, blood volume, and pressure fluctuations, which may influence the pathophysiology of headaches [6]. Pregnancy can also lead to secondary headaches triggered by eclampsia, pre-eclampsia, and idiopathic intracranial hypertension [7]. Given the potential severity and risks, unusual or severe headaches during pregnancy require immediate medical attention to ensure the health of the mother and child [8].

Headache is a frequent symptom during pregnancy and the postpartum period, requiring careful attention owing to its potential for life-threatening conditions [9]. The prevalence of headache during pregnancy is as high as 35% [10].

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The emergence of a new type of headache or the onset of headache occurs in approximately 5% of pregnancies [11]. The most commonly reported headache conditions during pregnancy are primary headaches, specifically migraines without aura, followed by TTH and migraine with aura [12].

Primary headache disorders are characterized by the absence of any underlying diseases or processes as their cause. The three primary headache disorders recognized are the following: (1) migraine, (2) tension-type headache, and (3) trigeminal autonomic cephalalgia (TACs). Cluster headache is considered the prototypical example of TACs according to the classification established by the Headache Classification Committee of the International Headache Society in [13].

Tension-type headache (TTH) is a prevalent neurological condition affecting a significant number of individuals worldwide. It is characterized by recurring headaches that are generally mild to moderate in intensity. TTH headaches usually occur on both sides of the head and have a pressing or tightening sensation. Importantly, routine physical activity does not exacerbate these headaches [14].

Migraine is the most common cause of headaches in pregnant women. Migraine can be divided into two main types: migraine without aura (MO) and migraine with aura (MA). In a patient suffering from headaches and dizziness, vestibular migraine should also be considered [15].

Migraine auras are the sensory symptoms (neurologic, gastrointestinal, and autonomic) that may occur before or during a migraine attack. Migraine aura symptomatology includes temporary (< 60 min) visual symptoms, like blind spots (scotomas), zigzag lines, shimmering spots or stars, changes in vision, or vision loss or flashes of light; numbness; speech difficulties (dysarthria); and unilateral muscle weakness (arm or leg). None of them is a gastrointestinal or autonomic symptom, typically occurring during the acute pain phase [13].

In recent years, visual snow has been increasingly recognized as a separate syndrome from migraine. Patients suffer from similar visual symptoms, such as constantly seeing "snow," a persistent positive visual phenomenon reminiscent of grainy or pixelated television noise. This condition can significantly interfere with daily life and often leads to a large number of unnecessary examinations and treatment attempts [16].

It is important to note that primary headaches often undergo changes in their characteristics and patterns during pregnancy [10]. The diagnosis of primary headache was made by considering the patient's headache history and ruling out other potential causes. The International Classification of Headache Disorders provides clinical criteria that aid in the diagnosis of different types of headache [17].

During pregnancy, estrogen levels rise rapidly, coinciding with changes in headache patterns. In some women, significant fluctuations in circulating estrogen levels are associated with changes in headache frequency and severity [18]. Studies have shown that half to three-fourths of female migraines improve markedly during pregnancy, with a significant reduction in the frequency and intensity of migraine attacks [19]. However, women who experience migraines during pregnancy are more likely to have hypertensive disorders and stroke during pregnancy and the postpartum period [20].

The treatment of headaches in general, and migraines in particular, during pregnancy is challenging because of the risks to both the fetus and the mother (e.g., certain medications contraindicated in pregnancy and hormonal fluctuations, which can influence the frequency and severity of headaches) [21]. Therefore, migraineurs should be considered to be at a higher risk of complications during pregnancy and closely monitored [12].

This study aimed to evaluate the characteristics of headaches in pregnant women in order to provide valuable insights. Furthermore, this study examined the effect of the presence or absence of headaches, as well as headache intensity before pregnancy, on the types and intensity of headaches during pregnancy.

Methods

This cross-sectional study was conducted at the maternity emergency ward of the Afzalipour Teaching Hospital in Kerman City. The study included all pregnant women who were admitted to the maternity emergency ward between February 1, 2022, and July 30, 2023, and had a chief complaint of headache. Participants were selected through convenience sampling. The research team informed patients about the purpose of the study and obtained written informed consent from those willing to participate.

The patients underwent physical examination and assessment of their medical histories by an emergency physician. In addition, fever and blood pressure were measured. Fever was defined as a body temperature equal to or higher than 38.5 °C [16]. Simultaneously, elevated blood pressure was determined by a single measurement of systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg [6]. Trained nurses in the maternity emergency ward conducted interviews with the patients. They collected all the questionnaires, which were then evaluated by a neurologist on the research team to determine the type of headache.

Inclusion Criteria

The study included pregnant women, both primiparous and multiparous, who were over 18 years old and presented to

the maternity emergency ward with significant headache symptoms.

Exclusion Criteria

Pregnancies with known fetal complications, high-risk pregnancies, postpartum women, pregnant women who smoked cigarettes or used opiates, those under 18 years of age, and those who had MRI scans showing secondary headaches such as vascular, inflammatory, traumatic, and neoplastic etiologies [17] were excluded from the study.

Instruments

A demographic information form was used to collect independent variables such as age, parity (number of births), gestational age, education, and income. Additionally, this form included information about the history of headaches 6 months before pregnancy, frequency of headaches per month, and duration of headaches in hours during pregnancy. The visual analog scale (VAS) was used to measure the intensity of headaches before and during pregnancy.

The headache classification was based on the International Headache Society (IHS) criteria. In this study, we used the Farsi-translated version of the requirements and calculated a Cronbach's alpha coefficient of 0.78. According to the IHS criteria, women were categorized as having migraines, tension-type, or both, as well as other primary headaches [18]. The questionnaires were collected through interviews conducted by trained nurses. An automatic blood pressure monitor was used for all patients to ensure accurate measurements. Additionally, we checked for fever in all the patients using the same digital axillary thermometer.

Statistical Analyses

Univariate multinomial logistic regression was used to analyze the relationship between headache type (dependent variable) and independent variables (age, parity, gestational age, education, and income). In the univariate model, all independent variables with a *P*-value less than 0.2 were included in the multivariable model to ensure the inclusion of the most statistically significant variables [22]. A multivariable model was then used to determine the adjusted effect of these variables on headache type. Finally, a repeated measures model was applied to compare headache intensity before and during pregnancy based on headache type. Descriptive statistics are presented as means (standard deviations) for normally distributed scaled data and as frequency counts with percentages for categorical data. All analyses were conducted using SPSS V.26 (IBM Inc., Armonk, USA), with $P < 0.05$ considered significant.

Results

A total of 400 pregnant women were included in this study. A total of 231 (57.8) women were primiparous, and 169 (42.2) were multiparous. The women in this study had a mean age of 27.3 (SD = 5.06) years, a mean pregnancy gestational age of 32.2 (SD = 6.05) weeks, and parity (number of births) of 2 (SD = 0.70). In this study, 87 women (21.8%) reported a history of headache before pregnancy. In terms of women's education, 14.5% had completed schooling, 31.0% had obtained a diploma, and 54.5% had achieved a college education. The occupational distribution among women showed that 60.7% were housewives while 39.3% were employed. In terms of income, 18.7% of the participants reported having adequate income, while 15.8% indicated inadequate income. The majority, accounting for 66.4% of the participants, reported a middle-level income (Table 1).

The results showed that 296 (74.0%) of the pregnant women experienced tension-type headaches. A small proportion of the participants, 22 (5.5%), had experienced migraine with aura. The remaining 82 participants (20.5%) had experienced migraines without aura. In this study, we did not observe clusters, trigeminal autonomic cephalalgia, or other primary headaches. The average frequency of headaches per month was 2.7 (SD = 1.32). The average duration of the headaches, measured in hours, was 4.9

Table 1 Demographic characteristics of participants

Characteristic	Frequency	Percent
Education		
Under diploma	58	14.5
Diploma	124	31.0
University	218	54.5
Job status		
Household	243	60.7
Employee	157	39.3
Level income		
Inadequate	63	15.8
Middle	266	66.4
Adequate	71	18.7
Medical history		
Gestational diabetes	51	12.8
Hypertension	63	15.8
Asthma	10	2.5
Healthy women	276	68.9
Primiparous	231	57.8
Multiparous	169	42.2
	Mean	SD
Age (yr)	27.36	5.06
Gestational age (wk)	32.27	6.05

Table 2 Characteristic headaches in pregnant women

IHS diagnosis	Frequency	Percent
Tension-type headache	296	74.0
Migraine with aura	22	5.5
Migraine without aura	82	20.5
Headache before pregnancy		
Yes	87	21.8
No	313	78.3
	Mean	SD
Headache duration/hours	4.95	5.45
Frequency of headache/month	2.71	1.32
Headache intensity before pregnancy	3.02	1.83
Headache intensity during pregnancy	4.08	1.75

Table 3 Frequency of preeclampsia in pregnant women

Variable	Preeclampsia (non-existence)	Preeclampsia (existence)	*P*-value	RR (95% CI)
Primiparous	220	11	0.151	1.74 (0.81, 3.74)
Multiparous	155	14		

RR relative risk

(SD = 5.45). The reported average intensity of headaches before pregnancy was 3.02 (SD = 1.83) on the VAS scale, whereas during pregnancy, the average intensity was 4.0 (SD = 1.75) (Table 2).

In this study, we had no cases of multiparous women with a history of eclampsia or TIA/stroke. However, the results of pre-eclampsia are shown in Table 3.

The relative risk of preeclampsia is 1.74 times higher in multiparous women than in primiparous women, but this risk is not statistically significantly different between the two groups of primiparous and multiparous women. In addition, 10 patients had visual snow. Twenty-one patients showed improvement during the first trimester of pregnancy, which is a natural occurrence in migraine. Sixteen patients showed improvement during the entire pregnancy.

Multivariable Regression Results

Based on the univariate multinomial logistic regression, age and gestational age were identified as significant factors for headache type. After including both variables in the multivariate regression, a significant effect was observed. Multivariable analysis revealed that age and gestational age were significantly associated with an increased likelihood of experiencing migraine without aura (OR = 1.10, $P = 0.047$ and OR = 1.08, $P = 0.028$, respectively). In other words, older women had a 1.10-fold increased risk of experiencing migraines without aura during pregnancy, and the likelihood of migraines without aura increased by 1.08 with increasing gestational age.

Additionally, the analysis showed that no history of headaches before pregnancy was a significant factor in increasing the likelihood of experiencing tension-type headaches (OR = 34.00, $P = 0.001$) (Table 4).

Mann–Whitney *U* Test Results

The Mann–Whitney *U* test was used to compare the duration, frequency, and intensity of headaches between the two groups of pregnant women: those with a history of headaches and those without. The results showed a statistically

Table 4 The effects of age and obstetric variables, and headache before pregnancy on headache types using multinomial logistic regression

Variables		Univariate multinomial logistic regression				Multivariable multinomial logistic regression			
	Headache types	OR	95% CI for OR		*P*-value	OR	95% CI for OR		*P*-value
			Lower	Upper			Lower	Upper	
Age	Tension-type headache	1.03	0.94	1.16	0.573	1.01	0.93	1.12	0.792
	Migraine without aura	1.11	1.01	1.23	0.041	1.10	1.00	1.22	0.047
Parity	Tension	1.00	0.54	1.86	.997	-	-	-	-
	Migraine without aura	1.05	0.57	2.06	0.894	-	-	-	-
Gestational age	Tension-type headache	1.06	0.98	1.13	0.123	1.05	0.99	1.12	0.123
	Migraine without aura	1.09	1.02	1.18	0.021	1.08	1.01	1.18	0.028
Headache before pregnancy (Non-present) Present (Ref)	Tension-type headache	34.00	4.513	256.305	0.001	34.00	4.517	257.621	0.001
	Migraine without aura	1.96	0.228	16.83	0.540	1.90	.220	16.487	0.558

Reference group: Migraine with aura; headache before pregnancy (present)

CI confidence interval, *OR* odds ratio

significant difference in the intensity of all types of headaches during pregnancy ($P < 0.001$). On average, pregnant women who experienced headaches before pregnancy had longer durations and more frequent headaches during pregnancy (Table 5).

Repeated Measures ANOVA Results

The results revealed significant changes in headache intensity before and during pregnancy for all three types of headaches. Repeated-measures ANOVA showed a significant interaction effect between time and headache type for VAS ($P < 0.001$). The main effect of time on headache intensity was also significant ($P < 0.0001$). Additionally, the headache type had a significant impact on headache intensity ($P < 0.001$) (Table 6).

Based on these findings, there was a significant variation in headache intensity before pregnancy across the three types of headaches, with migraines without aura displaying higher intensity. Moreover, during pregnancy, there was a significant difference in headache intensity among the three types of headaches, with tension-type headaches being the most intense (Table 7).

Discussion

Headaches are a common problem for many people, especially for women. Therefore, it is not surprising that pregnant women often experience these symptoms [23]. Headaches during pregnancy require special attention as they can be a symptom of secondary diseases. At the same time, a pre-existing primary headache can influence the course of the pregnancy and childbirth and increase the risk of complications [19].

This study aimed to evaluate the characteristics of headaches in pregnant women. We found that tension-type headaches were more frequent in pregnant women than [describe the migraine with aura] among pregnant women. In addition, we observed migraines with and without aura in the same sample. Previous studies have shown that the majority of headaches experienced during pregnancy are attributed to primary headache types such as migraines and tension-type headaches [24, 25].

The results showed a significant relationship between increasing women's age and gestational age with migraines without aura when compared to migraines with aura as the reference group. Migraine headaches often improve during pregnancy, but they have also been known to worsen or start

Table 5 Relationship between headache before pregnancy and headache intensity, frequency, and duration during pregnancy

Independent variable	Dependent variables		
Headache before pregnancy	Headache intensity mean (SD)	Headache duration mean (SD)	Headache frequency mean (SD)
Non-present	4.52 (4.68)	2.28 (1.15)	2.70 (1.31)
Present	5.35 (6.05)	3.67 (2.06)	2.72 (1.32)
P-value	< 0.001	0.521	0.850

Table 6 Relationship between headache types and headache intensity in pregnancy

	Source	Type II sum of squares	Mean square	*F*	*P*-value
Headache intensity	Measurement time	90.04	90.04	66.58	< 0.001
	Headache type	38.62	19.31	10.84	< 0.001
	Measurement time* Headache type	1271.39	635.69	470.07	< 0.001

Table 7 Headache intensity before and during pregnancy in three headache types

	Time	Headache types			*P*-value
		Tension-type headache (TTH)	Migraine with aura	Migraine without aura	
Headache intensity	Before pregnancy	2.15 ± 1.01	4.77 ± 1.27	5.66 ± 1.33	< 0.001
	During pregnancy	4.71 ± 1.46	2.27 ± 1.43	2.29 ± 1.08	< 0.001

during pregnancy due to estrogen and progesterone levels. Almost half of women with migraine experience improvement during the first trimester, and this improvement significantly in the second and third trimesters [26]. The number of women with complete remission in the first trimester is low (10.6%); however, as the pregnancy progresses, the rate of complete remission increases significantly (78.7% in the third trimester). For migraine with aura, the probability of improvement or remission is lower than for migraine without aura [27].

However, our results showed that the risk of migraine without aura also increased with increasing gestational age. We hypothesize that this difference from other studies may be due to the fact that pregnant migraine patients are significantly more likely to complain of anxiety, stress, vital exhaustion, short sleep duration, excessive daytime sleepiness, and depression, which occurred in the last weeks of pregnancy and could represent a dysfunction of the serotonergic and dopaminergic systems [28, 29].

Migraine is more age-dependent in women than in men and decreases with increasing age [30]. The frequency of attacks also differs between the age groups. Migraine without aura (MO) occurs more frequently in 18- to 29-year-olds than in 40- to 49-year-olds [31]. The frequency of migraine peaks around the age of 35 and affects 25–30% of women. With increasing age, the likelihood of developing migraine decreases and reaches its lowest point at around the age of 50 years of age [32]. However, previous studies have identified maternal age as a contributing factor [33]. Due to the complex nature of common migraine, it is also important to consider the effects of all genes and their interactions with environmental factors that contribute to the condition, which remains a challenge [34].

Previous studies have shown that migraine attacks tend to increase during the first trimester of pregnancy but are expected to decrease later [35]. It is important to note that pregnancy can alter migraine aura and may trigger attacks of the aura without headaches [36]. However, in our study, we did not observe any effect of parity (number of births) on the type of headache experienced.

The results revealed that women who did not have a history of headaches before pregnancy had an increased risk of developing tension-type headaches compared with women who had a history of headaches before pregnancy. Tension-type headaches are a common occurrence in clinical practice. Despite numerous clinical and neurophysiological studies, the exact mechanisms behind tension-type headaches are still not clear. However, most studies suggest that pain sensitization, myofascial contractions, hormonal changes, physical changes, stress, and emotional factors may play a role [37].

Tension-type headaches often occur in women during pregnancy due to hormonal changes, specifically fluctuations in estrogen [38]. These hormonal changes affect the levels of neurochemicals that play crucial roles in transmitting pain signals, such as serotonin, gamma-aminobutyric acid, and enkephalins [39]. Additionally, some research have suggested that women without a history of headache may experience severe headaches, which could indicate elevated blood pressure or neurological abnormalities. These symptoms are considered warning signs of a secondary cause of acute headaches during pregnancy [17].

Moreover, we observed a significant difference in headache intensity among the three types of headaches based on their history. In other words, women who had experienced headaches before pregnancy reported a higher intensity of tension-type headaches, migraines without aura, and aura migraines. However, there were no significant differences in terms of frequency and duration. Previous studies have shown that a history of headache before pregnancy is a significant predictor of headache [15]. This effect may be attributed to changes in headache patterns, including frequency, intensity, and duration, which are caused by elevated estrogen levels, endogenous opioids, and stressful events during pregnancy [31].

Furthermore, other findings have indicated a noteworthy interaction effect between time and headache intensity. Considering the average values, we noticed a decrease in the intensity of migraines without aura and migraine with aura, whereas tension-type headaches experienced an increase in intensity with increased gestational age. The gradual improvement in migraine symptoms appears to be linked to an increase in endogenous blood levels of estrogen and progesterone during pregnancy. This increase is crucial for the normal course of migraines [40]. However, as pregnancy progresses, accompanied by stress and fatigue in women, tension-type headaches worsen [41].

There are some limitations of the present study that should be considered. This study was cross-sectional and was performed at only one center. The hospital was a referral hospital for the territory. However, we recommend further research in multiple centers to generalize our results to a larger sample size for all women. Additionally, we recommend conducting a cohort study to follow up pregnant women with headaches.

Future Direction

To the best of our knowledge, we suggest utilizing the VAS for accurate screening by healthcare providers. Additionally, we propose creating an information bank that provides women with a daily electronic calendar to document the characteristics of their headaches. This would involve recording the intensity, frequency, and duration of headaches based on their specific gestational age. At the end of each

designated period, this information is collected, enabling healthcare providers to effectively track and manage headaches during pregnancy.

These insights can assist clinicians in accurately identifying the type of headache and tailoring the treatment accordingly. It is important to note that each headache type requires different treatments. Furthermore, this study focused on gaining a thorough understanding of the patient's headache history, which is crucial for establishing a diagnosis of persistent migraine and distinguishing it from other secondary causes. Despite the frequent occurrence of headaches during pregnancy, this study will help prevent misdiagnosis during the evaluation of headache disorders in obstetric triage and maternity emergency wards.

Conclusion

This study focused on evaluating the characteristics of headaches in pregnant women and revealed that tension-type headaches, migraines with aura, and migraines without aura were prevalent in this population. The risk of migraines without aura increases with advancing gestational age and in older women. The probability of experiencing tension-type headaches was higher in women without a history of headaches before pregnancy, suggesting that it occurs due to the potential influence of hormonal changes during pregnancy. Generally, women with a pre-existing history of headaches experience a higher intensity, frequency, and duration of headaches during pregnancy. These findings contribute to a better understanding of headaches during pregnancy and emphasize the importance of tailored management strategies for pregnant women experiencing these symptoms, particularly in emergency settings.

Author Contribution FA and EK designed the study. HEM and FI were the investigators. JG and O conducted data curation and analysis. All authors read and approved the final manuscript.

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Data Availability The authors confirm that the data supporting the findings of this study are available within the article and its supplementary material. Raw data that support the findings of this study are available from the corresponding author, upon reasonable request.

Code Availability Not applicable.

Declarations

Ethics Approval Ethics approval and consent to participate for this research were obtained from the Research Ethics Committee of Kerman University (ethics approval number IR.KMU.REC.1402.315).

Consent to Participate All participants have consented to participate.

Consent for Publication All authors agree to the publication of the article and give credit for any reproduced images.

Conflict of Interest The authors declare no competing interests.

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