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Original Article

Maternal Anemia in Abadan, Southwestern Iran: Prevalence, Underlying Factors and Food Pattern Dilemmas

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ABSTRACT

Background and Objectives: Maternal anemia is associated to premature birth and fetal disorders. The aim of this study was to estimate prevalence of maternal anemia and identify its underlying causes in pregnant women.

Materials and Methods: In this descriptive-analytical cross-sectional survey, 301 Iranian pregnant women aged 15–42 y of 5–40 gestational weeks referred to comprehensive health centers in Abadan, Iran, were selected. First, anthropometric indices were measured. Then, obstetric, sociodemographic characteristics and disease history were collected using self-designed questionnaires. Laboratory data documented in the electronic health records were used to assess maternal anemia. Dietary intake was assessed using 168-item qualitative food frequency questionnaires. Descriptive statistics, independent T-test, Chi-square tests and logistic regression were used to analyse data using IBM SPSS statistics software.

Results: Rate of the maternal anemia was 20.3%; of which, 75, 23.4 and 1.6% were mild, moderate and severe anemia, respectively. History of anemia before pregnancy enhanced the risk of maternal anemia (OR=6.048, 95% CI: 2.00–18.27, p=0.001). Moreover, 6–10 times weekly iron supplementation during pregnancy protected women from anemia, compared to 1–5 times weekly iron supplementation (OR=2.799, 95% CI: 1.438–5.450, p=0.002). Anemic women had less frequent intakes of bell peppers, dates and pomegranates than non-anemic women.

Conclusions: This study highlights the importance of obstetric and nutritional factors as well as positive roles of healthy dietary patterns and appropriate uses of iron supplements in controlling anemia.

Keywords: Anemia, Risk factors, Pregnant women, Iron supplementation, Abadan, Iran

Introduction

Anemia is characterized by decreases in serum concentrations of hemoglobin (Hgb), hematocrit (Hct) or red blood cell (RBC) count, decreasing capacity of RBCs to transport oxygen to tissues (1). Maternal anemia is diagnosed during each trimester if the serum concentration of Hgb is less than 11 g/dl (2). Anemia is a global public health concern affecting 32.4 m (38.2%) pregnant women (3). The World Health Organization (WHO) has estimated prevalence of anemia in Iranian pregnant women as 40.5%, indicating severe public health problems (4). Moreover, several studies on Iranian pregnant mothers have reported the prevalence of anemia as 4.7–22.5% (5–7), with a higher prevalence in rural woman than urban women (6). To the best of the authors' knowledge, a few studies have been published regarding the prevalence of anemia in pregnant mothers living in Abadan, Khuzestan Province, Southwestern Iran. In Khuzestan Comprehensive Health Study (KCHS), age and sex-standardized prevalence rate of anemia was reported as 10.86% (8). Another study investigating prevalence of low birth weight (LBW) and its

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associated causes in pregnant mothers showed that the risk of LBW was twice higher in mothers with Hgb ≤ 11 g/dl than those with Hgb > 11 g/dl (9).

Anemia is one of the major causes of morbidity and mortality in pregnant women in developing countries (10), which is associated with consequences such as premature birth, LBW, mentally fetal disorders, low appearance, pulse, grimace, activity and respiration scores and death of the mothers and fetuses (11). Global statistics have reported nearly 510,000 maternal deaths per year linked to childbirth or preterm birth, with approximately 20% of these deaths occurring due to anemia. In addition, recovery of iron stores in postpartum period is often delayed in women, who experience iron deficiency anemia (IDA) during pregnancy (12).

Indicators of maternal anemia include nutrition (e.g., iron and folic acid deficiencies), infectious diseases (e.g., malaria and helminthic diseases), genetic disorders (e.g., thalassaemia), IDA, anthropometric indicators, previous delivery methods, gestational age, delivery, short intervals between deliveries, history of excessive bleeding during menstruation, parasitic intestinal infections, malaria, chronic diseases, bleeding, irregular iron consumption and inappropriate taking of nutritional supplements (13–16). Having a history of anemia in previous pregnancies, number of previous pregnancies, abortion history, history of bleeding in previous pregnancies, wanted or unwanted pregnancies, low dietary intakes and low biological availability of iron, diets rich in fibers and phytates (17), malabsorption, haemolysis or a combination of these disorders are other affecting factors of maternal anemia (16, 18). Effects of these factors have been reported differently in various regions of the world (19). Therefore, prevalence of anemia varies based on the variations in the major characteristics of the target population, methodological variances such as laboratory tests, anemia definitions and dietary diversities (20). Due to the lack of up-to-date and comprehensive information on the anemia prevalence and its indicators in pregnant women in Abadan, Iran, the major aims of this study were to estimate frequency of maternal anemia and assess its underlying factors in pregnant mothers living in Abadan, Iran.

Materials and Methods

Study design and sampling

This descriptive-analytical cross-sectional survey was carried out in 301 Iranian pregnant women aged 15–42 y of 5–40 gestational weeks, April 21, 2020, to February 15, 2021, who were referred for pregnancy care services to comprehensive health centers covered by the Vice-Chancellor of Health of Abadan University of Medical Sciences located in Abadan, Khuzestan Province, Southwest Iran. Pregnant mothers, whose pregnancies were verified by physicians or midwives, who were visited at least once in health centers, who delivered children in 2021 and who agreed to participate in the study, were selected and registered. Participants were selected using multistage random sampling method (Figure 1). Health centers in Abadan are categorized into three regions, including urban, rural and marginal regions. Each region was located in one category, with four health centers were selected in each category. Random sampling was carried out in 12 health centers in urban, rural and marginal regions of Abadan, Iran.

Ratio estimation formula was used to assess the sample size, where alpha was 0.05. Based on the results of previous similar studies (5), p = 0.307, d = 0.0614 and the final sample size was estimated as 217 people. Regarding possibility of dropout in sample collection, necessary information were collected from 301 pregnant women. Based on the number of pregnant women, registered and eligible samples included 6.3, 7.6 and 7% of the total population of pregnant women covered by the urban, rural and marginal health centers of Abadan, Iran. Written informed consents were collected from all participants after clarifying objectives of the study. Study was carried out based on the Declaration of Helsinki and approved by the Ethics Committee of Abadan University of Medical Science (ethics approval no. IR.ABADANUMS.REC. 1399.152).

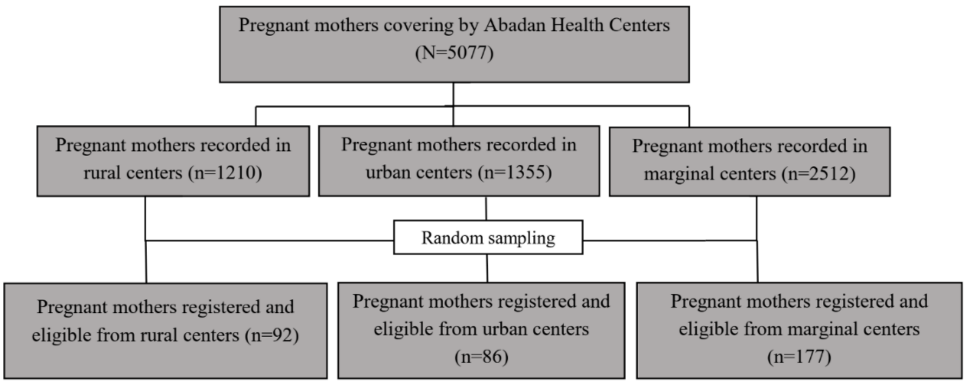

Figure 1. Schematic diagram of the multistage random sampling

Inclusion criteria and confounding factors

Inclusion criteria were willingness to participate in the study and not suffering from tuberculosis, sickle cell disease or thalassemia. Confounding factors were the history of chronic, congenital and genetic forms of fibroids; thyroid diseases; high blood pressure; diabetes mellitus; kidney diseases; heart diseases; and other diseases. To control these confounders, pregnant mothers were asked about their disease histories. Then, effects of these diseases on the chance of maternal anemia were analysed using multivariable logistic regression model.

Data collection and questionnaire

In the National Maternal Health Care Program, all pregnant mothers are examined using complete blood count tests, including Hgb and Hct in the first (6–10 w) and third (26–30 w) trimesters (5). Therefore, laboratory data documented in the electronic health records of pregnant mothers were used to assess maternal anemia. Then, pregnant mothers with serum Hgb of less than 11 g/dl were categorized as anemic women and those with serum Hgb of equal to or greater than 11 g/dl were categorized as non-anemic women (21). Furthermore, severity of the anemia during pregnancy was classified into three categories based on the criteria of WHO as follows. (1) mild (Hgb = 10.0–10.9 g/dl), (2) moderate (Hgb = 7.0–9.9 g/dl) and (3) severe (Hgb < 7.0 g/dl) anemias (21).

Additionally, risk factors associated to maternal anemia in anemic and non-anemic groups were collected using self-designed questionnaire based on an interview. Sociodemographic features of the participants were collected using questionnaires, including the mother's age (years), place of birth (Khuzestan and other provinces), educational level of the mother (illiterate, 1–8 classes, 9–12 classes, >12 classes); urban or rural residency; type of house (apartment, non-apartment, personal, non-personal); occupation status of the mother (housewife, self-employed, governmental); and occupation status of the husband (self-employed; employee: farmer, worker and service) (5, 22). In addition, obstetric variables, including trimester of pregnancy (first, second or third), childbirth status (no previous births or multiple births), age of menstruation (years), history of abnormal pregnancy (no, yes), number of times pre-pregnancy care was received (no care; once, twice or more care); number of times care was received during the pregnancy (less than six times, six times or more); intervals between pregnancies (less than one year, one year, two years, three years, more than three years, first pregnancy); abortion history in the last 6 m (yes, no); history of premature birth (yes, no); history of homebirth (yes, no); private care (yes, no); number of children (zero, one, two, three or more); and number of previous pregnancies (zero, one, two, three or more), were collected using questionnaires.

Disease history was collected using self-designed questionnaire as follows. History of any type of anemia before the pregnancy (yes, no); risks and diseases in the current or previous pregnancies, including preeclampsia/eclampsia, placental abruption, placenta previa, multiple pregnancies, postpartum hemorrhage, late labour, premature labour, difficult labour, rapid labour, abortion, caesarean, stillbirth, ectopic pregnancy, infant death, LBW or macrosomia, nutritional deficiencies, congenital disorders, chronic diseases and drug allergies (no, at least one risk or disease); and history of chronic, congenital or genetic diseases (fibroids, thyroid diseases, high blood pressure, diabetes mellitus, kidney diseases, heart diseases, other diseases, none). Moreover, information on receiving iron supplements before pregnancy (always, sometimes, none); receiving iron and folic acid supplements during pregnancy (1–5 times weekly, 6–10 times weekly) (5); and history of coffee consumption (yes, no) (23) were collected using self-designed questionnaires.

Anthropometric measurements

Body weight of the participants was measured to the nearest 100 g. Mothers were weighed using dial scale (Seca, Japan) while barefooted and minimally clothed. The average weight of the clothes (0.5 kg) was later subtracted from the measured weight. Height was measured with an accuracy of 0.1 mm using stadiometer. Then, body mass index (BMI) (kg/m^2) was calculated to assess nutritional statuses (24).

Assessment of dietary intake

Dietary intake of the participants was assessed via interviews based on a 168-item qualitative food frequency questionnaire (FFQ) on a daily, weekly, monthly, yearly and no-intake bases during the first or second visits (25, 26). To facilitate analysis of data from the FFQ, food items were divided into eight groups based on the healthy eating pyramid (27) as follows: (1) whole grains, (2) legumes, (3) vegetables, (4) healthy proteins, (5) fruits, (6) dairy foods, (7) healthy oils and (8) unhealthy foods. Whole grains included rice, wheat breads, potato, corn, vermicelli, noodles, barley and bulgur. Legumes included beans, chickpeas, broad beans, soybeans, lentils, mung beans and cobs. Vegetables included green leafy vegetables, cauliflower, pumpkin and other vegetables that the participants harvested in their fields or bought from the markets. Healthy proteins included chicken and fish. Fruits included all seasonal and non-seasonal fruits. Dairy foods included milk, yogurt, buttermilk, curd and cheese. Healthy oils included all types of liquid oils. Unhealthy foods included hamburgers and sausages, pickled and salted cucumbers, butter, margarine and cream, sugar, honey, jam, soft drinks, dumplings, candies, puffs, chocolates, chips, sugary halva, cookies, cakes and biscuits. It is noteworthy that this survey did not provide information regarding quantities of food intakes over time (28).

Statistical analysis

Normality test for the distribution of data was used for each variable in addition to Kolmogorov-Smirnov test. Prevalence of anemia and its degrees in pregnant mothers were assessed using descriptive statistics. Independent T-test was used to assess differences between the anemic and non-anemic groups in terms of quantitative risk factors and results were expressed as mean ±SD (standard deviation). Moreover, chi-square test was used to assess differences between the anemic and non-anemic groups for qualitative risk factors and intakes of foods and results were expressed as numbers (%). Logistic regression model was used applying forward method to assess effects of the risk factors on the chance of maternal anemia and the odds ratio (OR), adjusted odds ratio (AOR) and 95% confidence interval (95% CI) were assessed. In general, $p < 0.05$ was recorded as significance and data were analysed using SPSS statistics software v.26 (IBM, USA).

Results

A total of 5077 pregnant mothers were registered in Abadan, Iran, 2021. Data were collected from 301 pregnant mothers, who visited at least one urban, rural or marginal health center and gave birth in 2021. The mean age of pregnant mothers was 28.4 y ±5.7 with a range of 15–42 y. The mean gestational age of mothers at the first prenatal visit was 25.3 w ±9.7 with a range of 5–40 w. Of the participants, 40.5% were primiparous. Number of the prenatal care visits was 2 ±0.8 with a range of 1–3 times. The mean BMI before and during pregnancy was 26.5 ±5.7 (with a range of 14.8–46 kg/m^2) and 28 ±5.8 kg/m^2 (with a range of 15.1–46.6 kg/m^2), respectively.

The mean Hgb concentration in anemic and non-anemic mothers was 10.09 ±0.74 and 12.3 ±0.84 g/dl, respectively ($p \leq 0.001$). Moreover, rate of anemia in the second and third trimesters was 20.3%; of which, 75, 23.4 and 1.6% were respectively mild, moderate and severe anemia. However, results of the ANOVA did not show any significant differences between the pregnant mothers in the mild, moderate and severe classes of maternal anemia for quantitative factors, including age, weight, BMI in pre-pregnancy, BMI in pregnancy, gestational age, age of first menstruation, marriage age, number of previous births, number of pre-pregnancy cares, number of cares during pregnancy, number of previous pregnancies, number of children and intervals between the pregnancies. Table 1 shows medical and healthcare characteristics of the study participants. Non-anemic pregnant mothers had a lower gestational age and less prenatal care during pregnancy than those the anemic pregnant mothers had (p = 0.034 and 0.045, respectively).

In addition, Table 2 reports demographic characteristics and disease history of the study participants. Results showed significant differences between the pregnant mothers with anemia and non-anemic women for the risk factors of residence, history of anemia before pregnancy, risk of diseases in the current or previous pregnancies, iron supplementation during pregnancy and disease history. Therefore, 45 anemic (73.8%) and 208 non-anemic (86.7%) women were from city, whereas 16 anemic (26.2%) and 32 non-anemic (13.3%) women were from villages (p<0.05). Moreover, proportion of pregnant mothers without history of anemia before pregnancy in the non-anemic group was higher than that in the anemic group. However, more non-anemic women had no history of anemia before pregnancy, compared to those with anemia during pregnancy (p<0.05). In addition, further anemic women had at least one risk or disease in the current or previous pregnancy, compared to those without maternal anemia (p ≤ 0.001).

Table 1. Anthropometric and obstetric characteristics of the anemic and non-anemic pregnant mothers*

Variables / Study groups	Anaemic (n=61)	Non- Anaemic (n=240)	*p*-value
Body mass index in pre-pregnancy (kg/m2)	26.5 ± 5.5	26.5 ± 5.8	1
Body mass index in pregnancy (kg/m2)	28.2 ± 5.7	28 ± 5.9	NS
Gestational age (week)	27.7 ± 8.7	24.7 ± 9.9	**< 0.05**
Age of first menstruation (year)	11.9 ± 1.5	12.1 ± 1.3	NS
Marriage age (year)	22.4 ± 4.1	21.8 ± 4.4	NS
Number of births in the past	1.0 ± 1.1	1.0 ± 1.1	NS
Number of pre-pregnancy cares	2.1 ± 0.7	2 ± 0.8	NS
Number of cares during pregnancy	1.6 ± 0.5	1.5 ±0.5	**< 0.05**
Number of previous pregnancies	1.6 ± 1.6	1.5 ±1.4	NS
Number of children	2.0 ± 1.0	2.0 ±1.0	NS
The interval between pregnancies (year)	4.5 ± 1.6	4.6 ±1.5	NS

* The independent sample t-test was used to analyze the data. The results are expressed as mean ± standard deviation.

Table 2. Demographic characteristics and disease history of the anemic and non-anemic pregnant mothers*

Variable	Study groups	Anaemic (n=61)	Non- anaemic (n=240)	*p*-value
Age (year)		29.5 ± 5.4	28.3 ± 6.1	NS
Education level	Illiterate	3 (4.9%)	6 (2.5%)	NS
	High school	22 (36.1%)	99 (41.3%)	
	Diploma	21 (34.4%)	84 (35%)	
	Academic	15 (24.6%)	51 (21.3%)	
Resident area	Urban	45 (73.8%)	208 (86.7%)	<0.05
	Rural	16 (26.2%)	32 (13.3%)	
Occupation	Housewife	58 (95.1%)	226 (94.2%)	NS
	Self-employed	1 (1.6%)	2 (0.8%)	
	Employee	2 (3.3%)	12 (5%)	
Husband's occupation	Self-employed	40 (65.6%)	179 (74.6%)	NS
	Employee	21 (34.4%)	61 (25.4%)	
Desire to get pregnant	Wanted	55 (90.2%)	209 (87.1%)	NS
	Did not want	6 (9.8%)	29 (12.1%)	
History of iron supplementation before pregnancy	Always	2 (3.3%)	24 (10%)	NS
	Sometimes	31 (50.8%)	106 (44.2%)	
	No consumption	28 (45.9%)	110 (45.8%)	
Abortion history in the last 6 months	Yes	6 (9.8%)	22 (9.2%)	NS
	No	55 (90.2%)	218 (90.8%)	
Coffee intake	Yes	9 (14.8%)	24 (10%)	NS
	No	52 (85.2%)	215 (89.6%)	
History of home birth	Yes	0 (0%)	2 (0.8%)	NS
	No	61 (100%)	238 (99.2%)	
History of premature child birth	Yes	2 (3.3%)	11 (4.6%)	NS
	No	59 (96.7%)	229 (95.4%)	
History of anaemia before pregnancy	Yes	4 (6.6%)	49 (20.4%)	<0.05
	No	57 (93.4%)	191 (79.6%)	
Risk or disease in current or previous Pregnancy	No risk or disease	13 (21.3%)	142 (59.2%)	≤0.001
	At least one risk or disease	48 (78.7%)	98 (40.8%)	
Folic acid supplementation during pregnancy	1 to 5 times	31 (50.8%)	122 (50.8%)	NS
	6 to 10 times	30 (49.2%)	118 (49.2%)	
Iron supplementation during pregnancy	1 to 5 times	16 (26.2%)	123 (51.2%)	≤0.001
	6 to 10 times	45 (73.8%)	117 (48.2%)	
Type of house	Personal apartment	9 (14.8%)	29 (12.1%)	NS
	Impersonal apartment	12 (19.7%)	23 (9.6%)	
	Personal non-apartment	21 (34.4%)	110 (45.8%)	
	Impersonal non-apartment	19 (31.1%)	78 (32.5%)	
Private Care	Yes	35 (57.4%)	135 (56.3%)	NS
	No	26 (42.6%)	105 (43.8%)	
Number of children	Without children	24 (20.3%)	100 (41.7%)	NS
	1	20 (32.8%)	68 (28.3%)	
	2	11 (18%)	53 (22.1%)	
	3 or more	6 (9.8%)	19 (7.9%)	
History of disease	Fibroma	1 (1.6%)	0 (0%)	<0.01
	Thyroid diseases	7 (11.5%)	21 (8.8%)	
	Hypertension and diabetes mellitus	2 (3.3%)	1 (0.4%)	
	Hypertension	1 (1.6%)	7 (2.9%)	
	Diabetes mellitus	1 (1.6%)	15 (6.3%)	
	Kidney diseases	1 (1.6%)	2 (0.8%)	
	Heart diseases	0 (0%)	2 (0.8%)	
	Other diseases	0 (0%)	24 (10%)	
	None of the diseases	48 (78.8%)	149 (62.1%)	

* Chi-Square test was used to analyze qualitatively and an independent sample t-test was used to analyze quantitative data. The results are expressed as mean ± standard deviation for quantitative and number (percentage) for qualitative data.

Table 3. Forward logistic regression analysis to associate with anthropometric, obstetric and demographic factors and disease history with maternal anemia*

Variable		Uni-variable Analysis			Multi-variable Analysis		
		COR	95% CI	*p*-value	AOR	95% CI	***p*-value**
Age (year)		0.969	0.925-1.015	NS	-	-	-
Body mass index in pre-pregnancy (kg/m2)		1.007	0.978-1.036	NS	-	-	-
Body mass index in pregnancy (kg/m2)		0.994	0.948-1.044	NS	-	-	-
Gestational age (week)		0.968	0.939-0.998	**<0.05**	-	-	-
Age of first menstruation (year)		1.039	0.882-1.355	NS	-	-	-
Marriage age (year)		0.972	0.912-1.035	NS	-	-	-
Number of births in the past		0.997	0.766-1.298	NS	-	-	-
Number of pre-pregnancy cares		0.877	0.602-1.278	NS	-	-	-
Number of cares during pregnancy		1.769	1.009-3.196	**<0.05**	-	-	-
Number of previous pregnancies		0.962	0.759-1.163	NS	-	-	-
Number of children		0.995	0.748-1.324	NS	-	-	-
The interval between pregnancies (year)		1.062	0.883-1.276	NS	-	-	-
Education level	Illiterate	0.588	0.131-2.638	NS	-	-	-
	Under diploma	1.324	0.633-2.769	-	-	-	-
	Diploma	1.176	0.557-2.487	-	-	-	-
	Academic (Ref.)	1	-	-	-	-	-
Resident area	Urban	2.311	1.169-4.576	**<0.05**	-	-	-
	Rural (Ref.)	1	-	-	-	-	-
Type of house	Personal apartment	0.785	0.319-1.931	NS	-	-	-
	Impersonal apartment	0.467	0.198-1.103	NS	-	-	-
	Personal non-apartment	1.276	0.642-2.531	NS	-	-	-
	Impersonal non-apartment (Ref.)	1	-	-	-	-	-
Occupation	Housewife	0.649	0.141-2.983	NS	-	-	-
	Self-employed	0.333	0.020-5.643	NS	-	-	-
	Employee	1	-	-	-	-	-
Husband's occupation	Self-employed	1.541	0.843-2.815	NS	-	-	-
	Employee (Ref.)	1	-	-	-	-	-
History of Iron supplementation before pregnancy	Always	3.055	0.681-13.703	NS	-	-	-
	Sometimes	0.870	0.489-1.549	NS	-	-	-
	No intake (Ref.)	1	-	-	-	-	-
History of abortion in the last 6 months	Yes	0.925	0.358-2.392	NS	-	-	-
	No (Ref.)	1	-	-	-	-	-
Coffee intake	Yes	0.645	0.283-1.470	NS	-	-	-
	No (Ref.)	1	-	-	-	-	-
History of premature childbirth	Yes	1.417	0.306-6.568	NS	-	-	-
	No (Ref.)	1	-	-	-	-	-
History of anaemia before pregnancy	Yes	3.656	1.265 -10.565	**<0.05**	6.048	2.002-18.270	**≤ 0.001**
	No (Ref.)	1	-	-	-	-	-
Risk or disease in a current or previous pregnancy	No risk or disease	5.350	2.752 -10.400	**≤ 0.001**	5.539	2.783-11.002	**≤ 0.001**
	At least one risk or disease (Ref.)	1	-	-	-	-	-
Folic acids supplementation during pregnancy	1 to 5 times a week	1.001	0.570 -1.755	NS	-	-	-
	6 to 10 times a week (Ref.)	1	-	-	-	-	-
Iron supplementation during pregnancy	1 to 5 Times a Week	2.957	1.584-5.519	**0.001**	2.799	1.438-5.450	**<0.01**
	6 to 10 Times a Week (Ref.)	1	-	-	-	-	-
Private care	Yes	0.955	0.541 -1.685	NS	-	-	-
	No (Ref.)	1	-	-	-	-	-
History of disease	Fibroma	0.000	0.000-0.000	NS	-	-	-
	Thyroid diseases	1.000	0.000-0.000	NS	-	-	-
	Hypertension	0.000	0.000-0.000	NS	-	-	-
	Diabetes mellitus	0.000	0.000-0.000	NS	-	-	-
	Kidney diseases	1.000	0.000-0.000	NS	-	-	-
	Heart diseases	1.000	0.000-0.000	NS	-	-	-
	None of the diseases (Ref.)	1	-	-	-	-	-

*Logistic regression was used for data analysis. OR, odds ratio; AOR, adjusted odds ratio; 95% CI, 95% confidence interval

Regarding iron supplementation during pregnancy, further anemic women received iron supplements only 1–5 times a week, compared to non-anemic women (p≤0.001). Regarding disease history, history of diabetes and hypertension was more frequent in anemic pregnant mothers than non-anemic mothers. Furthermore, having no history of diseases was more frequent in anemic pregnant women than non-anemic pregnant women (p<0.01).

Factors affecting maternal anemia were assessed using regression analysis and forward method (Table 3). Anthropometric variables in the analysis included pre-gestational and gestational BMIs. Moreover, age of menstruation, number of times pre-gestational care was received, number of times care was received during pregnancy, number of previous pregnancies, intervals between the pregnancies, abortion history in the last 6 m, history of premature labour and private care were the obstetric variables included in the analysis. In addition, sociodemographic characteristics, including educational level, mother's age, current residency, type of house, occupation status, husband's occupation, age of marriage and number of children were included in the analysis. Receiving iron supplements before pregnancy, history of coffee consumption, iron supplements during pregnancy and folic acid supplementation during pregnancy were included in the analysis as well. In addition, history of anemia before pregnancy, risks and diseases in the current or previous pregnancy and disease history were included in the analysis. History of anemia before pregnancy, risks or diseases in the current or previous pregnancy and iron supplementation during pregnancy were in the equation.

History of anemia before pregnancy was the most potent risk factor affecting chance of gestational anemia as the odds ratio for women who had a history of anemia before pregnancy was 6.048 (**p** ≤ 0.001), compared to women who had no history of anemia before pregnancy. Moreover, risks or diseases in the current or previous pregnancy was identified as the second strongest risk factor for gestational anemia. Chance of maternal anemia in women who did not have risks or diseases in the current or previous pregnancy was 5.5 times higher than that in women who had at least one risk or disease in the current or previous pregnancy (p≤0.001). Moreover, iron supplementation during pregnancy was a protective factor against maternal anemia, as the odds ratio of pregnant women who received iron supplements 1–5 times a week increased by 2.8 times, compared to women who received iron supplements 6–10 times a week during pregnancy (p<0.01).

In addition, results of univariate logistic regression analysis showed that higher gestational age (p<0.05) and adequate care during pregnancy (p < 0.05) were associated with 1-fold decreases and 1.8-fold increase in risks of gestational anemia, respectively. Moreover, pregnant women living in urban areas were 2.3 times more likely to develop anemia than those living in rural areas (**p** < 0.05). However, these variables did not included in the model after the multivariate logistic regression was carried out.

Table 4. Comparison of anemic and non-anemic women for the intake frequencies of various foods*

Food items/Frequency	Study groups	Anaemic (n=61)	Non- anaemic (n=240)	*p*-value
Bell pepper	Weekly	1 (2.4%)	17 (10.8%)	
	Monthly	38 (90.5%)	133 (84.7%)	
	Yearly	3 (7.1%)	2 (1.3%)	<0.05
	No consumption	0 (0%)	5 (3.2%)	
Pomegranate	Weekly	1 (2.4%)	4 (2.5%)	
	Monthly	0 (0%)	4 (2.5%)	
	Yearly	36 (87.8%)	149 (94.3%)	<0.01
	No consumption	4 (9.8%)	1 (0.6%)	
Dates	Daily	16 (39%)	103 (65.6%)	
	Weekly	25 (61%)	50 (31.8%)	
	Monthly	0 (0%)	3 (1.9%)	<0.01
	Yearly	0 (0%)	1 (0.6%)	
Cookie	Weekly	12 (28.6%)	27 (17.2%)	
	Monthly	19 (45.2%)	110 (70.1%)	
	Yearly	10 (23.8%)	16 (10.2%)	<0.05
	No consumption	1 (2.4%)	4 (2.5%)	
Pickled cucumber	weekly	39 (92.9%)	109 (69.4%)	
	Monthly	3 (7.1%)	46 (29.3%)	<0.05
	Yearly	0 (0%)	1 (0.6%)	
	No consumption	0 (0%)	1 (0.6%)	

*Chi-square statistical test was used for data analysis. The results are expressed as (percentage) number.

Discussion

The present study was the first study to investigate prevalence of maternal anemia and its associated underlying factors in pregnant mothers referring to health centers in Abadan, Iran, reporting the extent of anemia in urban and rural pregnant mothers. Importantly, these pregnant women had various educational levels and came from families of various socioeconomic backgrounds. Since this study included pregnant women who visited urban, rural and marginal health care centers for antenatal care, the participants might truly be representatives of their whole populations. Therefore, results can be addressed as the representatives of all pregnant women in Abadan, Iran.

Prevalence of maternal anemia and demographic factors

In the present study, nearly 20% of mothers were anemic in the second and third trimesters, with 75, 23.4 and 1.6% of women respectively having mild, moderate and severe anemia. These results were similar to those of the prevalence of anemia in Iranian pregnant mothers in the third trimester reported in a previous study (26.7%) (5). In a similar study on pregnant women referred to health centers in Khorramabad (Central Iran), prevalence of anemia was 16.8% (29). Furthermore, results of similar studies on Asian and African pregnant mothers were close to the findings of the present study. Such studies reported that the prevalence of anemia in Turkish, Chinese and Ugandan women in the third trimester was 27.1, 26.2 and 22.1%, respectively (30–32). However, a lower prevalence of anemia was detected in Iranian pregnant women, compared to pregnant women in other developing countries. For example, this rate was 37% in India (33), 40% in Bangladesh (24), 56.8% in Eastern Ethiopia (34) and 42.7% in southern parts of Africa (35). The lower frequency of anemia in Iranian pregnant women might be due to the recent improvements in primary health care and prenatal programs (7).

This study demonstrated a higher prevalence of anemia in mothers living in urban areas, compared to those living in rural areas. This result is in contrast to other results of studies in Iran (36) as well as other parts of the world such as Ethiopia and Malawi (33, 37). The lower prevalence of anemia in rural pregnant women than the urban pregnant women reported in the current study might be due to the differences in socioeconomic conditions, high coverage of accessible health facilities and services in rural areas and personal and health-seeking behaviors, which decrease anemia prevalence in rural pregnant mothers (7). Moreover, these findings highlight the need of promoting free health services for the urban women of this city. In this study, a further prevalence of maternal anemia was reported in higher mother's age and those with a high gestational age. Similar studies in Iranian, Arab and Bangladeshi women reported increases of anemia between the first and third trimesters of pregnancy (5, 33). Increased blood volume and gradual decline of body iron storage may worsen anemia during pregnancy (38). Moreover, in the present study, anemic pregnant women received prenatal care during pregnancy more often than that non-anemic women did. This finding might be due to the higher frequency of referrals to health centers by the pregnant women with anemia, compared to that by the non-anemic women due to their greater needs for monthly check-ups by healthcare providers.

Associations between the maternal anemia with a history of anemia before pregnancy and risks or diseases in the current or previous pregnancy

Findings of the present study revealed that a history of anemia before pregnancy increased the risk of maternal anemia by up to six times. Similarly, a study in Saudi Arabia reported that a history of anemia before pregnancy was associated with increased risks of maternal anemia (39). These results strongly recommended IDA screening for pregnant mothers with a personal or family history of IDA. This study reported that the prevalence of anemia in women who did not have risk factors or diseases in the current or previous pregnancy was 5.5 times higher than that in women who had at least one risk factor or disease in the current or previous pregnancy. However, no such differences were reported between the anemic and non-anemic participants in a study on Iranian mothers regarding risks or diseases in the present or previous pregnancy (5). Based on the results of the cuurent study, it can be concluded that the occurrence of maternal anemia is not affected by the history of risks or diseases in the current or previous pregnancy.

Effects of iron supplementation during pregnancy on the odds of maternal anemia

This study revealed that iron supplementation 6–10 times a week was a protective factor against gestational anemia. Based on previous studies, dietary insufficiency of iron and inappropriate use of supplements were reported as underlying causes of maternal anemia (4, 5). Iron supplementation simultaneously with folic acid is a protective strategy to control anemia during pregnancy and after childbirth (40, 41). However, irregular intake of iron supplementation cannot prevent anemia (5). This finding was similar to that from pregnant women living in urban areas in Ethiopia, where the inefficient use of iron supplements during pregnancy was significantly associated to anemia (34, 42). Therefore, regular iron supplementation is recommended for pregnant women; however, over-intakes of the suplement must be avoided (43).

Associations between the maternal anemia and food intake during pregnancy

Nutritional deficiency, particularly iron deficiency, is addressed as the most common cause of anemia in non-malaria endemic regions such as Iran (24). Low food diversity is another essential factor associated with the maternal anemia (42). The present findings revealed that nearly 11% of non-anemic and more than 2% of anemic individuals consumed bell peppers daily. Bell peppers (*Capsicum annuum* L.) are a vegetable known for its extremely high ascorbic acid (vitamin C) content as 100 g of bell pepper provide 100% of the recommended dietary allowance of vitamin C (60 mg/d). Considering dietary sources of iron consumed by the study groups did not show statistical significance differences. It could be concluded that consumption of vitamin C sources such as bell peppers during pregnancy is associated with decreased prevalence of maternal anemia in this population. Furthermore, bell pepper is a good source of vitamins A, E and B6 as well as folic acid, all of which effectively control anemia. Therefore, daily intake of bell peppers may stimulate haematopoiesis by improving body's absorption of iron (44).

Daily consumption of dates was detected higher in non-anemic women than anemic women. Dates (*Phoenix dactylifera*) are included in the most commonly consumed fruits in Abadan, Iran. Dates contain 0.3–10.4 mg of iron per 100 g as well as vitamin C, which increases iron absorption (45). Daily consumption of 100 g of dates for seven weeks in pregnant women was associated with higher serum concentrations of Hgb, supporting the current findings. Previous studies on anemic females (41) reported that the consumption of date products was associated to increased serum levels of Hgb, Hct and ferritin. Therefore, dates can improve serum concentration of Hgb by increasing the production of RBCs (45). These findings indicated that non-anemic women had further consumptions of pomegranates (*Punica granatum* L.) than that the anemic women had. Pomegranates are fruits that have been cultivated for centuries and include high nutritional and therapeutic values (46). Biological and therapeutic characteristics of pomegranates are primarily attributed to their content of polyphenols (ellagitannins, flavonoids, phenolic acids, stilbenes, tannins and anthocyanins) (47), which are free radical scavenging compounds (48). Pomegranates are rich in vitamins and minerals as well (49). Natural pomegranate juice contains approximately 13 mg of ascorbic acid per 100 ml, increasing iron's biological availability greater than three-fold (50). Further, two *in-vitro* models of IDA showed that pomegranate juice increased iron absorption by up to 50% and ferritin content by up to 30%, compared to that ascorbic acid supplementation did. These studies provided scientific evidence; based on which, use of pomegranates can be suggested for the control of IDA by facilitating availability and absorption of iron. In addition to the ascorbic acid content in pomegranate juice, the synergistic action of several phytochemicals might be responsible for improving iron bioavailability (50). Pomegranate juice is a rich source of polyphenols and thus may help RBCs and other cells fight with oxidative stress (51). Therefore, antioxidants such as polyphenols may help balance increased oxidative stress in RBCs, thus preventing their destruction (51). Previous studies have shown that pomegranate consumption is safe during pregnancy (52).

The present findings suggest that despite the low bioavailability of iron in dates and pomegranates, increased consumption of these fruits can improve iron resources of pregnant mothers with a little access to foods containing heme iron. However, further studies are needed to clarify whether pomegranates should be consumed to support prevention or treatment of maternal anemia. This study reported higher consumption rates of cookies and pickled cucumbers by the anemic pregnant mothers than the non-anemic pregnant mothers. Uunhealthy dietary patterns with the increased consumption of processed foods rich in simple sugar, sweeteners and salt have been cited as causes of increased obesity rates in recent years. Nevertheless, their consumption can affect pregnancy outcomes and long-term children's health is still indeterminate (53). Therefore, these findings suggest development of healthy dietary patterns focusing on fruit and vegetable consumption as well as decreasing consumption of unhealthy foods to prevent maternal anemia.

It is necessary to explain that differences between the prevalence of maternal anemia and its underlying factors in the present study with those in other studies in Iran and various regions worldwide could be due to differences in socioeconomic statuses, personal behaviors and health-seeking behaviors (33). The strength of this study included that it was the first study investigating prevalence of maternal anemia and its factors in Khuzestan Province, Southwest Iran. A significant limitation of the present study was the lack of investigation of nutrient statuses linked to anemia in pregnant mothers. Since changes in blood volume that occur physiologically during pregnancy prevent achievement of accurate results from the measurement of these nutrients, serum concentrations of nutrients were not assessed in this study. Moreover, further studies must be carried out to investigate effects of maternal anemia on pregnancy outcomes in pregnant women in Southwestern Iran.

Conclusions

The present study highlights needs of comprehensive intervention strategies that include obstetric and nutritional factors to decrease the prevalence of maternal anemia in this population. Positive roles of healthy dietary patterns and appropriate uses of iron supplements in controlling anemia can be promoted by health care services as well as in self-care practices. The current study recommends screening for all types of anemia in mothers, who decide to become pregnant but have personal or familial histories of anemia.

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References

1. Turner J, Parsi M, Badireddy M. Anemia. StatPearls. Treasure Island (FL)2022.
2. Weldekidan F, Kote M, Girma M, Boti N, Gultie T. Determinants of Anemia among Pregnant Women Attending Antenatal Clinic in Public Health Facilities at Durame Town: Unmatched Case Control Study. Anemia 2018;2018:8938307.
3. Berhe B, Mardu F, Legese H, Gebrewahd A, Gebremariam G, Tesfay K, et al. Prevalence of anemia and associated factors among pregnant women in Adigrat General Hospital, Tigrai, northern Ethiopia, 2018. BMC Res Notes 2019;12(1):310.
4. Worldwide prevalence of anaemia 1993–2005 WHO Global Database on Anaemia [Internet]. World Health Organization. 2008. Available from: https://apps.who.int/iris/bitstream/handle/10665/43894/9789241596657_eng.pdf?sequence=1&isAllowed=y.
5. Motlagh ME, Nasrollahpour Shirvani SD, Torkestani F, Hassanzadeh-Rostami Z, Rabiee SM, Ashrafian Amiri H, et al. The Frequency of Anemia and Underlying Factors among Iranian Pregnant Women from Provinces with Different Maternal Mortality Rate. Iran J Public Health 2019;48(2):338-44.
6. Azami M DZ, Sayehmiri K. Systematic Review and Meta-Analysis of the Prevalence of Anemia Among Pregnant Iranian Women (2005 - 2015). Shiraz E-Med J 2016;17((4-5)):e38462.
7. Barooti ER, S.B., Motaghipisheh, Sh., Tayeri, S., Arabi, M., Salahi, S., Haghdoost, A.,. Prevalence of Iron Deficiency Anemia among Iranian Pregnant Women; a Systematic Review and Meta analysis. J Reprod Infertil 2010;11(1):17-24.
8. Akbarpour E, Paridar Y, Mohammadi Z, Mard A, Danehchin L, Abolnezhadian F, et al. Anemia prevalence, severity, types and correlates among adult women and men in a multiethnic Iranian population: the Khuzestan Comprehensive Health Study (KCHS). BMC Public Health 2022;22(1):168.
9. R A. Assessment of the rate of low birth weight and its related factors in Ahvaz, Iran, in 1995 and 1996. Food and Nutrition Bulletin 2000;21(3):290-2.
10. Baig-Ansari N, Badruddin SH, Karmaliani R, Harris H, Jehan I, Pasha O, et al. Anemia prevalence and risk factors in pregnant women in an urban area of Pakistan. Food Nutr Bull 2008;29(2):132-9.
11. Ozturk M OO, Ulubay M, Karasahin E, Ozgurtas T, Yenen M, et al, Anemia prevalence at the time of pregnancy detection. Anemia prevalence at the time of pregnancy detection. Turk J Obstet Gynecol 2017;14(3):176-80.
12. Crawley J. Reducing the burden of anemia in infants and young children in malaria-endemic countries of Africa: from evidence to action. Am J Trop Med Hyg 2004;71(2 Suppl):25-34.
13. Balarajan Y, Ramakrishnan U, Ozaltin E, Shankar AH, Subramanian SV. Anaemia in low-income and middle-income countries. Lancet 2011;378(9809):2123-35.
14. Kumar A, Sharma E, Marley A, Samaan MA, Brookes MJ. Iron deficiency anaemia: pathophysiology, assessment, practical management. BMJ Open Gastroenterol 2022;9(1).
15. Gopalratnam K, Woodson KA, Rangunwala J, Sena K, Gupta M. A Rare Case of Stroke Secondary to Iron Deficiency Anemia in a Young Female Patient. Case Rep Med 2017;2017:1684631.
16. Tulu BD, Atomssa EM, Mengist HM. Determinants of anemia among pregnant women attending antenatal care in Horo Guduru Wollega Zone, West Ethiopia: Unmatched case-control study. PLoS One 2019;14(10):e0224514.
17. Mehrotra M, Yadav S, Deshpande A, Mehrotra H. A study of the prevalence of anemia and associated sociodemographic factors in pregnant women in Port Blair andaman and Nicobar Islands. J Family Med Prim Care 2018;7(6):1288-93.
18. Yuan Y, Cai Z, Dai Y, Hong Q, Wang X, Zhu L, et al. Association of Maternal Serum 25-Hydroxyvitamin D Concentrations with Risk of Gestational Anemia. Cell Physiol Biochem 2017;43(4):1526-32.
19. Yadav UK, Ghimire P, Amatya A, Lamichhane A. Factors Associated with Anemia among Pregnant Women of Underprivileged Ethnic Groups Attending Antenatal Care at Provincial Level Hospital of Province 2, Nepal. Anemia 2021;2021:8847472.
20. Sunuwar DR, Singh DR, Chaudhary NK, Pradhan PMS, Rai P, Tiwari K. Prevalence and factors associated with anemia among women of reproductive age in seven South and Southeast Asian countries: Evidence from nationally representative surveys. PLoS One 2020;15(8):e0236449.
21. Iron deficiency anemia assessment prevention and control: a guide for programme managers [Internet]. World Health Organization. 2001.
22. Keramat A LB, Adibi H, Chopra A, Kunjir VR, Patwardh B. Association between Demographic Factors and Osteoporosis in Urban Iranian Postmenopausal Women. Iranian J Publ Health, , A supplementary issue on Osteoporosis 2004:34-42.
23. Teshome MS, Meskel DH, Wondafrash B. Determinants of Anemia Among Pregnant Women Attending Antenatal Care Clinic at Public Health Facilities in Kacha Birra District, Southern Ethiopia. J Multidiscip Healthc 2020;13:1007-15.
24. Ahmed F, Mahmuda I, Sattar A, Akhtaruzzaman M. Anaemia and vitamin A deficiency in poor urban pregnant women of Bangladesh. Asia Pac J Clin Nutr 2003;12(4):460-6.

25. Paknahad Z, Fallah A, Moravejolahkami AR. Maternal Dietary Patterns and Their Association with Pregnancy Outcomes. Clin Nutr Res 2019;8(1):64-73.
26. Diamond-Smith NG, Gupta M, Kaur M, Kumar R. Determinants of Persistent Anemia in Poor, Urban Pregnant Women of Chandigarh City, North India: A Mixed Method Approach. Food Nutr Bull 2016;37(2):132-43.
27. The Nutrition Source, Healthy Eating Pyramid [Internet]. Harvard University. 2024 [cited 2024]. Available from: https://www.hsph.harvard.edu/nutritionsource/healthy-eating-pyramid/.
28. Bhandari S, Sayami JT, Thapa P, Sayami M, Kandel BP, Banjara MR. Dietary intake patterns and nutritional status of women of reproductive age in Nepal: findings from a health survey. Arch Public Health 2016;74:2.
29. Mardani M, Rezapour S, Ahmadipour S, Mohsenzadeh A, Khalkhali Rad AH, Roosta S, et al. Prevalence of anemia and its risk factors among pregnant women in Khorramabad (Iran) 2010-2014. J Matern Fetal Neonatal Med 2017;30(7):826-9.
30. Karaoglu L, Pehlivan E, Egri M, Deprem C, Gunes G, Genc MF, et al. The prevalence of nutritional anemia in pregnancy in an east Anatolian province, Turkey. BMC Public Health 2010;10:329.
31. Xiong X, Buekens P, Fraser WD, Guo Z. Anemia during pregnancy in a Chinese population. Int J Gynaecol Obstet 2003;83(2):159-64.
32. Obai G, Odongo P, Wanyama R. Prevalence of anaemia and associated risk factors among pregnant women attending antenatal care in Gulu and Hoima Regional Hospitals in Uganda: A cross sectional study. BMC Pregnancy Childbirth 2016;16:76.
33. Chowdhury HA, Ahmed KR, Jebunessa F, Akter J, Hossain S, Shahjahan M. Factors associated with maternal anaemia among pregnant women in Dhaka city. BMC Womens Health 2015;15:77.
34. Addis Alene K, Mohamed Dohe A. Prevalence of Anemia and Associated Factors among Pregnant Women in an Urban Area of Eastern Ethiopia. Anemia 2014;2014:561567.
35. Tunkyi K, Moodley J. Prevalence of anaemia in pregnancy in a regional health facility in South Africa. S Afr Med J 2015;106(1):101-4.
36. Zamani M, Poustchi H, Shayanrad A, Pourfarzi F, Farjam M, Noemani K, et al. Prevalence and determinants of anemia among Iranian population aged >/=35 years: A PERSIAN cohort-based cross-sectional study. PLoS One 2022;17(2):e0263795.
37. Getachew M YD, Tafess K, Getachew Y, Zeynudin A. Anaemia and associated risk factors among pregnant women in Gilgel Gibe dam area, Southwest Ethiopia. Parasites & Vectors 2012(5):296.
38. Barrett JF, Whittaker PG, Williams JG, Lind T. Absorption of non-haem iron from food during normal pregnancy. BMJ 1994;309(6947):79-82.
39. Alzaheb RA, Al-Amer O. The Prevalence of Iron Deficiency Anemia and its Associated Risk Factors Among a Sample of Female University Students in Tabuk, Saudi Arabia. Clin Med Insights Womens Health 2017;10:1179562X17745088.
40. Khambalia AZ, O'Connor DL, Macarthur C, Dupuis A, Zlotkin SH. Periconceptional iron supplementation does not reduce anemia or improve iron status among pregnant women in rural Bangladesh. Am J Clin Nutr 2009;90(5):1295-302.
41. Bhutta ZA, Das JK, Bahl R, Lawn JE, Salam RA, Paul VK, et al. Can available interventions end preventable deaths in mothers, newborn babies and stillbirths and at what cost? Lancet 2014;384(9940):347-70.
42. Lebso M, Anato A, Loha E. Prevalence of anemia and associated factors among pregnant women in Southern Ethiopia: A community based cross-sectional study. PLoS One 2017;12(12):e0188783.
43. Hovdenak N, Haram K. Influence of mineral and vitamin supplements on pregnancy outcome. Eur J Obstet Gynecol Reprod Biol 2012;164(2):127-32.
44. Simonne A SE, Eitenmille RR, Mills HA, Green NR. Ascorbic Acid and Provitamin a Contents in Unusually Colored Bell Peppers (Capsicum annuumL.). Journal of Food Composition and Analysis 1997;10(4):299-311.
45. Irandegani FA, A.; Ghaljaei, F.; Navidian, A.; Karajibani, M. The Effect of a Date Consumption-Based Nutritional Program on Iron Deficiency Anemia in Primary School Girls Aged 8 to 10 Years Old in Zahedan (Iran). Pediatric Health Med Ther 2019;10:183-8.
46. Vidal A, Fallarero A, Pena BR, Medina ME, Gra B, Rivera F, et al. Studies on the toxicity of Punica granatum L. (Punicaceae) whole fruit extracts. J Ethnopharmacol 2003;89(2-3):295-300.
47. Manthou EG, K.; Deli, C. K.; Sotiropoulos, A.; Fatouros, I. G.; Kouretas, D.; Haroutounian, S.; Matthaiou, C.; Koutedakis, Y.; Jamurtas, A. Z. Effect of pomegranate juice consumption on biochemical parameters and complete blood count. Exp Ther Med 2017;14(2):1756-62.
48. Gil MI, Tomas-Barberan FA, Hess-Pierce B, Holcroft DM, Kader AA. Antioxidant activity of pomegranate juice and its relationship with phenolic composition and processing. J Agric Food Chem 2000;48(10):4581-9.
49. Mirdehghan S, Rahemi, M. Seasonal changes of mineral nutrients and phenolics in pomegranate (Punica granatum L.) fruit. Scientia Horticulturae 2007;111:120–7.
50. Balasubramani SP, Varghese RK, Vishnuprasad CN, Venkatasubramanian P. Pomegranate Juice Enhances Iron Dialysability and Assimilation in In-Vitro Cell Free and Cell-Based Models. Plant Foods Hum Nutr 2020;75(2):272-8.
51. Manthou E, Georgakouli K, Deli CK, Sotiropoulos A, Fatouros IG, Kouretas D, et al. Effect of pomegranate juice consumption on biochemical parameters and complete blood count. Exp Ther Med 2017;14(2):1756-62.
52. Chen B, Longtine MS, Nelson DM. Punicalagin, a polyphenol in pomegranate juice, downregulates p53 and attenuates hypoxia-induced apoptosis in cultured human placental syncytiotrophoblasts. Am J Physiol Endocrinol Metab 2013;305(10):E1274-80.
53. Casas R, Castro Barquero S, Estruch R. Impact of Sugary Food Consumption on Pregnancy: A Review. Nutrients 2020;12(11).