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The Predictive Role of Social Determinants of Health and Substance Use Disorder in Adverse Maternal and Fetal Outcomes During Pregnancy

Fahimeh Mehrbani
Gonabad University of Medical Sciences
Fatemeh Mohammadzadeh
Gonabad University of Medical Sciences
Mahboubeh Gholami
Neyshabur University of Medical Sciences
Effat-al-Sadat Merghati Khoei
University of Technology Sydney
Narjes Bahri
nargesbahri@yahoo.com
Gonabad University of Medical Sciences

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Abstract

Introduction: Social determinants of health and substance use during pregnancy may contribute to adverse maternal and fetal outcomes. This study aimed to investigate the association of social determinants of health and substance use with adverse pregnancy outcomes among pregnant women. Methods: This cross-sectional study included 640 pregnant women admitted to the labor ward for childbirth. Participants were selected using simple random sampling and substance use was assessed using a standard urine-based substance screening kit. Demographic, reproductive, and Social Determinants of Health Checklist, Pregnancy Health Literacy Questionnaire, Multidimensional Scale of Perceived Social Support, and Household Food Insecurity Access Scale were used for data collection. Adverse maternal and fetal outcomes including miscarriage, premature rupture of membranes, preterm labor, preeclampsia, low birth weight, and intrauterine demise was recorded. Data were analyzed using SPSS version 27, and STATA version 13.0 with $p < 0.05$ considered statistically significant. Results: Among the 640 pregnant women, the median age was 28 years; 79.1% were housewives, and 42.0% had primary or middle school education. The addiction test was positive in 7.2% of participants. Preterm birth (6.8%) and low birth weight (8.6%) were the most frequently reported adverse maternal and fetal outcomes, respectively. In the multiple logistic regression model for adverse maternal outcomes, chronic disease (B = 0.72, SE = 0.34; p = 0.035), history of miscarriage (B = −1.62, SE = 0.32; p < 0.001), history of stillbirth (B = −1.90, SE = 0.60; p = 0.002), complications during the current pregnancy (B = −1.42, SE = 0.50; p = 0.004), and a positive addiction test (B = 2.07, SE = 0.37; p < 0.001) were significantly associated with the outcome. In the multiple logistic regression model for adverse fetal outcomes, maternal age (B = 0.06, SE = 0.03; p = 0.020), history of stillbirth (B = 1.89, SE = 0.72; p = 0.009), complications during the current pregnancy (B = 1.86, SE = 0.55; p < 0.001), and food insecurity (B = 0.19, SE = 0.05; p < 0.001) were significantly associated with adverse fetal outcomes. A positive addiction test was also significantly associated with adverse fetal outcomes (B = 2.17, SE = 0.42; p < 0.001). Conclusion: Substance use was significantly associated with both adverse maternal and fetal outcomes. History of miscarriage, history of stillbirth, complications during the current pregnancy, and chronic disease were also associated with adverse maternal outcomes, whereas maternal age, history of stillbirth, current pregnancy complications, and food insecurity were associated with adverse fetal outcomes. These findings highlight the potential importance of substance-use screening, appropriate management of high-risk pregnancies, and attention to food insecurity as part of comprehensive antenatal care.

Introduction

Pregnancy is a critical period during which the fetus is exposed to complex biological and environmental factors that can influence its developmental trajectory into adulthood (1). A major challenge to maternal and fetal health during pregnancy is substance use, which has also emerged as a growing public health concern (2, 3).

Over the past two decades, substance use among women has increased, with women accounting for approximately one-third of individuals with substance use disorders (4). Global estimates of substance use among pregnant women vary considerably. For example, according to the 2024 National Survey on Drug Use and Health (NSDUH), the prevalence of past-month illicit drug use among pregnant women in the United States was 5.3% (5)Whereas a study conducted in Singapore reported a prevalence of 0.018%(6). Also, studies conducted in Iran have reported varying prevalence estimates of substance abuse among pregnant women, including 1.66% in Babol, northern Iran(7), 23% positive urine screening tests in Southeastern Iran(8) and prevalence rates of 8.5% for waterpipe and 2.6% for opium in Southeast Iran (9). A recent systematic review and meta-analysis of Iranian studies estimated the overall prevalence of substance use among pregnant women at 3.3%, with an increasing temporal trend, rising from 2.1% during 2000–2009 to 3.8% during 2015–2024 (10).

Substance use during pregnancy can have serious consequences for maternal and fetal health, including preterm birth, miscarriage, stillbirth, low birth weight, intrauterine growth restriction, perinatal mortality, congenital anomalies, fetal distress, and neonatal withdrawal syndrome (11–15). In addition, children born to mothers who used drugs during pregnancy have a higher incidence of intellectual disabilities and Attention-Deficit/Hyperactivity Disorder (ADHD) than children born to mothers who did not use drugs (16).

Pregnancy outcomes among women with substance use disorders are closely associated with socioeconomic conditions. Evidence indicates that social factors at both the individual and environmental levels are important determinants of health, particularly during the first 1,000 days of life(17). Factors such as age, education, marital status, pregnancy intention, and, notably, the living environment or neighborhood can contribute to inequalities in maternal health outcomes (18). Furthermore, a systematic review identified structural factors, including economic conditions, access to healthcare, and racial inequalities, as major risk factors for maternal mortality (19).

The World Health Organization (WHO) defines social determinants of health (SDH) as the conditions in which people are born, grow, work, live, and age(20). The influence of social factors on health was first formally recognized and emphasized in the 1986 Ottawa Charter(21). Various factors, including poverty, homelessness, limited education, violence, and domestic insecurity, can increase the risk of substance use(22). In addition, factors such as younger age at first pregnancy, a spouse's low educational level, rural residence, limited access to healthcare, and a family history of substance use have been associated with an increased risk of substance use disorders (23–25).

Although numerous studies have investigated factors associated with maternal and fetal outcomes among women with substance use disorders, most have been conducted within specific geographic or cultural contexts, resulting in limited local evidence in this area. Moreover, the majority of previous studies have focused primarily on medical and biological factors, with comparatively less attention given to the social determinants of health that may influence pregnancy outcomes. Given this gap in the literature, the present cross-sectional study was conducted in Neyshabur, northeastern Iran, to examine the predictive role of social determinants of health and substance use disorders in adverse maternal outcomes.

Methods

Study design

This cross-sectional study was conducted between October and November 2025. The study protocol was approved by the Research Council of the Social Determinants of Health Research Center, Gonabad University of Medical Sciences, Iran. The study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (26).

Study participants

The study included pregnant women who presented to the hospital for childbirth in Neyshabur, northeastern Iran, in 2025. Inclusion criteria were being aged 18 years or older, having Iranian nationality, providing informed consent to participate, being able to read and write in Persian, understanding the Persian language, and having no severe mental disorders, such as schizophrenia or acute bipolar disorder (based on participants' medical records and documented medical history). The exclusion criteria were withdrawal from participation and questionnaires with more than 10% missing responses (27)

Sample size and sampling

Based on an anticipated prevalence of adverse pregnancy outcomes of approximately 40%, as reported in previous studies (27–29), and the conventional rule of at least 10 outcome events per predictor parameter in logistic regression analysis, the minimum required sample size was estimated to be 625 participants, assuming approximately 25 predictor parameters in the final model. After accounting for an anticipated 10% loss due to non-response or incomplete data, the required sample size was increased to 695 participants.

Simple random sampling was conducted daily over the two-month data collection period. Approximately 10 pregnant women were randomly selected each day from the list of women presenting to the labor ward. Women who met the eligibility criteria were invited to participate in the study.

Study Instruments

a. Demographic, Reproductive, and Social Determinants of Health Checklist

This researcher-developed checklist was designed based on the study objectives and a review of the relevant literature. The initial items were developed to cover the main study variables and data collection requirements. The checklist was then reviewed by experts in the relevant field to assess the relevance, clarity, and comprehensiveness of its items, and revisions were made based on their feedback.

This checklist was developed in three sections. The first section included variables such as age, age at menarche, age at marriage, duration of marriage, educational level, spouse's educational level, occupation, spouse's occupation, childhood socioeconomic status, current socioeconomic status, housing status, and place of residence. The second section included adverse maternal and fetal outcomes in the current pregnancy including miscarriage, premature rupture of membranes, preterm labor, preeclampsia, low birth weight, and intrauterine demise. The third section documented the results of urine drug screening and the substances detected, including amphetamine, methamphetamine, cannabis, morphine, and methadone.

b. Pregnancy Health Literacy Questionnaire

In this study, pregnancy health literacy, considered a social determinant of health, was assessed using the Pregnancy Health Literacy Questionnaire. The original 26-item questionnaire was developed and administered in Nigeria as the Maternal Health Literacy and Pregnancy Outcome Questionnaire (MHLAPQ), which includes 14 items assessing health literacy and 12 assessing pregnancy outcomes, with a reported Cronbach's alpha of 0.81 (28). Its psychometric properties were subsequently evaluated among pregnant Iranian women by Kharazi et al., confirming reliability with a Cronbach's alpha greater than 0.60 (29). In the present study, only the 14-item health literacy section was used. Items were rated on a 5-point Likert scale (Strongly Agree = 5 to Strongly Disagree = 1). Higher scores indicate higher levels of maternal health literacy during pregnancy. In the current study, its reliability was reassessed in the target population and confirmed as a Cronbach's alpha of 0.76.

c. Multidimensional Scale of Perceived Social Support (MSPSS)

Perceived social support, a social determinant of health, was assessed using the 12-item Multidimensional Scale of Perceived Social Support (MSPSS), developed by Zimet et al. in 1988 (30). The scale assesses support from family, friends, and significant others through three four-item subscales. Items are rated on a seven-point Likert scale, with total scores ranging from 12 to 84; higher scores indicate greater perceived social support. Scores are categorized as low (12–36), moderate (37–60), and high (61–84). The MSPSS has demonstrated good construct and convergent validity, with Cronbach's alpha coefficients of 0.85–0.91 and test–retest reliability of 0.72 in the original study (30). The questionnaire has been used among Iranian pregnant women by Bahmard et al., with a reported Cronbach's alpha coefficient of 0.89 (31). In the current study, we reassessed its reliability in the study population and confirmed it, yielding a Cronbach's alpha of 0.70.

d. Household Food Insecurity Access Scale (HFIAS)

Food insecurity, a social determinant of health, was assessed using the Household Food Insecurity Access Scale (HFIAS), developed by the Food and Nutrition Technical Assistance (FANTA) Project of USAID in 2007 to assess household food access during the previous 30 days (32). The HFIAS consists of nine items addressing anxiety about food availability, inadequate food quality, and insufficient food quantity. Items are scored from 0 (never) to 3 (often), yielding a total score of 0–27, with higher scores indicating greater food insecurity. Based on FANTA criteria, households are classified as food secure, mildly, moderately, or severely food insecure(32).

The original HFIAS demonstrated good reliability, with Cronbach's alpha coefficients of 0.85–0.91 and test–retest correlations of approximately 0.70–0.80 (32). Its reliability has also been confirmed in Iranian populations, with Cronbach's alpha coefficients of 0.95 and 0.89 (33, 34). In the present study, the reliability of the questionnaire was reassessed in the study population and confirmed, with a Cronbach's alpha coefficient of 0.88.

Study procedure

Eligible pregnant women attending the labor ward were enrolled in the study after providing written informed consent. All study data were collected in the postpartum ward after the mother's clinical condition had stabilized following delivery. At this stage, the questionnaires were completed by the first researcher during the participants' hospital stay and before discharge, based on information obtained from medical records and, when required, direct interviews with the participants.

Urine samples were also collected for substance screening using the Vitrotec ® drug screening kit (Pharmed Behin Azma Co., Iran) to detect amphetamine, methamphetamine, cannabis, morphine, and methadone. The screening procedure was conducted according to the manufacturer's instructions.

Data Analysis

Data were analyzed using SPSS version 27 and STATA version 13.0. The normality of quantitative variables was assessed using the Kolmogorov–Smirnov test. Categorical variables were summarized as frequencies and percentages, while non-normally distributed quantitative variables were presented as medians and interquartile ranges (IQRs). Differences between mothers with and without adverse maternal or fetal outcomes were assessed using the Mann–Whitney U test for quantitative variables and the chi-square or Fisher's exact test for categorical variables. A two-sided P value < 0.05 was considered statistically significant.

Firth's penalized logistic regression was used to examine the associations of structural and intermediate social determinants of health, as well as substance use, with adverse maternal and fetal outcomes. Two separate composite outcomes were defined: adverse maternal outcomes, comprising miscarriage, premature rupture of membranes, preterm labor, and preeclampsia; and adverse fetal outcomes, comprising low birth weight and intrauterine fetal demise. For each composite outcome, the occurrence of at least one component was considered an adverse outcome. Variables with P < 0.15 in univariable logistic regression analyses were selected for inclusion in the corresponding multivariable Firth's penalized logistic regression models. Statistical significance was set at P < 0.05.

Results

Demographic and Reproductive Characteristics of the Participants

A total of 640 pregnant women were included in the study. The median age of the participants was 28 (IQR: 24.0, 35.0) years, while the median ages at menarche and marriage were 12 (IQR: 12.0, 14.0) and 18 (IQR: 16.0, 22.0) years, respectively. Regarding obstetric and medical history, the median number of previous pregnancies was 2.0 (IQR: 1.0, 3.0). A history of miscarriage was reported (23.1%), and a history of stillbirth was (3.6%). Furthermore, complications in previous pregnancies were (13.1%), and (13.4%) had underlying chronic diseases (Table 1).

Structural Social Determinants of Health

An analysis of social determinants of health showed that, in terms of educational attainment, the largest proportion of participants had primary or middle school education (42%), followed by those with a high school diploma (38.9%); only 2% had a university degree. Regarding employment status, the majority of participants were homemakers (79.1%). Among participants' spouses, the most common occupations were self-employment (35.8%) and manual labor (34.8%).

Regarding socioeconomic status, most participants reported a low level of socioeconomic status. Specifically, 83.4% rated their childhood socioeconomic status as low, while 88.9% reported a low current socioeconomic status. In addition, 50.9% of participants lived in their own homes, and 55.2% resided in rural areas (Table 1).

Intermediate Social Determinants of Health

Results indicated a mean prenatal health literacy score of 54.94, reflecting a high level among participants in this area. The mean perceived social support score was reported as 57.41, placing it in the moderate support category based on the scale's cut-off points. Additionally, the mean food

insecurity score was estimated at 8.17, indicating that the study population falls within the moderate food insecurity range (Table 1).

Table 1
Demographic and social determinants of Health characteristics of the participants

Variable	Median	First quartile, third quartile
Demographic and Reproductive Characteristics		
Age (years)	28.0	24.0, 35.0
Age at menarche (years)	12.0	12.0, 14.0
Age at marriage (years)	18.0	16.0, 22.0
Duration of marriage (years)	7.0	4.0, 13.0
Number of previous pregnancies	2.0	1.0, 3.0
History of miscarriage	**Number**	**%**
Yes	148	23.1
No	492	76.9
History of stillbirth	**Number**	**%**
Yes	23	3.6
No	617	96.4
Complications in previous pregnancies	**Number**	**%**
Yes	84	13.1
No	556	86.9
Presence of chronic diseases	**Number**	**%**
Yes	**86**	**13.4**
No	**554**	**86.6**
Structural Social Determinants of Health		
Education Level	**Number**	**%**
Illiterate	109	17.0
Primary & Middle School	269	42.0
High School Diploma	249	38.9
University Degree	13	2.0
Spouse's Education level		
Illiterate	121	18.9
Primary & Middle School	288	45.0
High School Diploma	175	27.3
University Degree	56	8.8
Occupation		
Homemaker	506	79.1
Home-based Business	40	6.3
Employee	5	0.8
Retired	1	0.2
Laborer	46	7.2
Other	42	6.6
Spouse's Occupation		
Employee	33	5.2
Laborer	223	34.8

Variable	Median	First quartile, third quartile
Self-employed	229	35.8
Unemployed	26	4.1
Retired	17	2.7
Other	112	17.5
Childhood Socioeconomic Status		
Low	534	83.4
Medium	78	12.2
High	28	4.4
Current Socioeconomic Status		
Low	569	88.9
Medium	45	7.0
High	26	4.1
Housing Status		
Owned	326	50.9
Rented	265	41.4
Living with Relatives	49	7.7
Place of Residence		
Urban	287	44.8
Rural	353	55.2
Intermediate Social Determinants of Health	**Mean**	**Standard deviation**
Pregnancy health literacy	54.94	5.22
Perceived social support	57.41	13.39
Food insecurity	8.17	4.13

Substance Use and Urine Drug Screening Results

The urine screening results for substance use were positive in 7.2% of the participants. Among participants, the highest positivity rates were observed for methadone (62.2%) and morphine (60.0%). Positive results for methamphetamine, cannabis, and amphetamine were also observed in 24.4%, 22.2%, and 15.6% of these participants, respectively (Table 2).

Table 2
Frequency distribution of drug test results and types of substances used among participants

Variable	Category	Number	Percentage
Addiction test result	Positive	46	7.2
	Negative	594	92.8
	Total	640	100.0
Type of substance used			
Amphetamine	Yes	7	15.6
	No	38	84.4
	Total	45	100.0
Methamphetamine	Yes	11	24.4
	No	34	75.6
	Total	45	100.0
Cannabis	Yes	10	22.2
	No	35	77.8
	Total	45	100.0
Morphine	Yes	27	60.0
	No	18	40.0
	Total	45	100.0
Methadone	Yes	28	62.2
	No	17	37.8
	Total	45	100.0

Prevalence of Adverse Maternal and Fetal Outcomes

Thirteen percent of the participants experienced at least one adverse pregnancy outcome. The most common adverse outcome was preterm birth (8.6%). Additionally, 3.6% of the participants experienced miscarriage, 4.7% experienced premature rupture of membranes, and 1.7% experienced pre-eclampsia (Table 3).

Among the participants, 3.7% experienced adverse fetal outcomes. Among the adverse fetal outcomes assessed, low birth weight was the most common, occurring in 8.6% of participants, followed by intrauterine fetal death, which occurred in 5.0% (Table 3).

Table 3
Frequency distribution of adverse maternal and fetal outcomes among participants

Variable	Category	Number	Percentage
Adverse maternal outcomes	Yes	83	13.0
	No	557	87.0
	Total	640	100.0
Type of outcome			
Miscarriage	Yes	23	3.6
	No	617	96.4
	Total	640	100.0
Premature rupture of membranes	Yes	30	4.7
	No	610	95.3
	Total	640	100.0
Preterm birth	Yes	55	8.6
	No	585	91.4
	Total	640	100.0
Preeclampsia	Yes	11	1.7
	No	629	98.3
	Total	640	100.0
Adverse fetal outcomes	Yes	47	7.3
	No	539	92.7
	Total	586	100.0
Type of outcome			
Low birth weight	Yes	44	6.8
	No	596	93.2
	Total	650	100.0
Intrauterine fetal death	Yes	3	0.5
	No	637	99.5
	Total	640	100.0

Associations of Social Determinants of Health and Substance Use with Adverse Maternal and Fetal Outcomes

Univariate Analyses

According to the univariate results regarding factors associated with adverse maternal outcomes, the following variables qualified for the multivariate penalized logistic regression model: age, marriage order, number of pregnancies, chronic disease, history of complications in previous pregnancies, presence of complications in the current pregnancy, current socioeconomic status, history of stillbirth, history of miscarriage, maternal health literacy score, food insecurity score, and drug test result.

Associations of Social Determinants of Health and Substance Use with Adverse Maternal and Fetal Outcomes

Multivariate Analysis

Factors Associated with Adverse Maternal Outcomes

The results of the final regression model indicated that, among the individual and familial variables, only chronic disease was significantly associated with adverse maternal outcomes (β = 0.72, SE = 0.34, 95% CI: 0.39–1.05, p = 0.035). Other variables in this domain—including age and marriage order—did not show a significant association with adverse maternal outcomes (p > 0.05).

Among reproductive and obstetric characteristics, three variables—history of miscarriage, history of stillbirth, and the presence of complications in the current pregnancy—were identified as significant predictors. These included history of miscarriage (coefficient: 1.62; SE: 0.32; 95% CI: 0.99–2.26; p < 0.001), history of stillbirth (coefficient: 1.90; SE: 0.60; 95% CI: 0.72–3.09; p = 0.002), and complications in the current pregnancy (coefficient: 1.42; SE: 0.50; 95% CI: 0.44–2.40; p = 0.004). In contrast, the number of pregnancies and a history of complications in previous pregnancies were not significantly associated with the outcome (p > 0.05).

Regarding socio-structural factors, current economic status (at medium and high levels compared to the low level) did not show a significant association with adverse pregnancy outcomes (p > 0.05). Similarly, intermediate social factors—including reproductive health literacy and food insecurity—did not demonstrate a significant association with adverse maternal outcomes (p > 0.05).

Factors Associated with Adverse Fetal Outcomes

Finally, after adjusting for the effects of other variables in the model, addiction was identified as a strong risk factor (coefficient: 2.07; SE: 0.37; 95% CI: 1.33–2.81; p < 0.001)

In the final model, maternal age was significantly associated with adverse fetal outcomes among individual and family-level factors (β = 0.06, SE = 0.03; 95% CI: 0.009–0.12; p = 0.02). In contrast, marriage order and chronic illness were not significantly associated with the outcome (p > 0.05).

Among reproductive and obstetric characteristics, a history of stillbirth and complications during the current pregnancy were significantly associated with adverse fetal outcomes. A history of stillbirth was associated with higher odds of adverse fetal outcomes (β = 1.89, SE = 0.72; 95% CI: 0.48–3.30; p = 0.009), as were complications during the current pregnancy (β = 1.86, SE = 0.55; 95% CI: 0.78–2.94; p = 0.001). The number of pregnancies and a history of complications in previous pregnancies were not significantly associated with the outcome (p > 0.05).

Regarding socio-structural factors, neither current economic status nor place of residence was significantly associated with adverse fetal outcomes (p > 0.05). Among socio-intermediate factors, food insecurity was significantly associated with the outcome (β = 0.19, SE = 0.05; 95% CI: 0.09–0.29; p = 0.001). After adjustment for covariates, addiction remained significantly associated with adverse fetal outcomes (β = 2.17, SE = 0.42; 95% CI: 1.34–3.00; p < 0.001) (Table 4).

Table 4
Factors associated with adverse maternal outcomes based on the results of penalized multiple logistic regression

		Adverse maternal outcomes				**Adverse fetal outcomes**			
		Simple logistic regression		**Multiple logistic regression**		**Simple logistic regression**		**Multiple logistic regression**	
Variable	Category	B (SE)	P-value	B (SE)	P-value	B (SE)	P-value	B (SE)	P-value
Individual and family characteristics									
Age	-	0.03(0.01)	**0.022**	0.02(0.02)	0.196	0.05(0.02)	**0.012**	0.06(0.03)	**0.020**
Spouse's age	-	0.02(0.01)	0.070	-	-	0.03(0.01)	0.022	-	-
Age at menarche	-	0.02(0.08)	0.824	-	-	0.06(1.38)	0.564	-	-
Age at marriage	-	0.02(0.02)	0.394	-	-	0.007(0.02)	0.770	-	-
Duration of marriage	-	0.01(0.02)	0.585	-	-	0.02(0.02)	0.433	-	-
Marital order	First	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Second	0.73(0.37)	**0.049**	-0.37(0.49)	0.450	0.97(0.43)	**0.024**	-0.16(0.58)	0.778
	Third	0.45(1.48)	**0.763**	-0.63(1.59)	0.692	0.21(1.48)	0.887	0.93(1.59)	0.559
Consanguineous marriage with spouse	No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Yes	0.49(0.35)	0.164	-	-	0.44(0.45)	0.328	-	-
Chronic disease	No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Yes	0.95(0.28)	**< 0.001**	0.72(0.34)	**0.035**	0.77(0.36)	**0.032**	0.77(0.44)	0.082
Reproductive and obstetric characteristics									
Number of pregnancies	-	0.25(0.07)	**< 0.001**	-0.12(0.11)	0.263	0.18(0.08)	**0.038**	-0.09(0.14)	0.487
Number of deliveries	-	-0.08(0.10)	0.434	-	-	0.14(0.12)	0.231	-	-
History of miscarriage	No	Reference	Reference	Reference	Reference	Reference	Reference		
	Yes	1.52(0.24)	**< 0.001**	-1.62(0.32)	**< 0.001**	0.28(0.34)	0.403	-	-
History of stillbirth	No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Yes	2.30(0.43)	**< 0.001**	-1.90(0.60)	**0.002**	2.28(0.45)	**< 0.001**	1.89(0.72)	**0.009**
History of complications in previous pregnancies	No	Reference	Reference	Reference	Reference	Reference	Reference		
	Yes	1.22(0.28)	**< 0.001**	0.34(0.44)	0.435	1.05(0.34)	**0.002**	-0.29(0.61)	0.630
Complication in the current pregnancy	No	Reference	Reference	Reference	Reference	Reference	Reference		
	Yes	1.60(0.41)	**< 0.001**	-1.42(0.50)	**0.004**	1.96(0.45)	**< 0.001**	1.86(0.55)	**< 0.001**
Current pregnancy planned	No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Yes	-0.16(0.23)	0.506	-	-	-0.38(0.31)	0.218	-	-
Prenatal care	No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Yes	-0.02(0.24)	0.926	-	-	-0.20(0.30)	0.514	-	-
Socio-structural factors									
Education	Illiterate	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Diploma or lower	-0.22(0.30)	0.465	-	-	0.09(0.41)	0.826	-	-
	University education	0.64(0.67)	0.344	-	-	1.08(0.79)	0.170	-	-

		Adverse maternal outcomes				Adverse fetal outcomes			
		Simple logistic regression		**Multiple logistic regression**		**Simple logistic regression**		**Multiple logistic regression**	
Spouse's education	Illiterate	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Diploma or lower	-0.19(0.29)	0.499	-	-	−0.48(0.35)	0.170	-	-
	University education	-0.33(0.49)	0.500	-	-	-	0.902	-	-
Occupation	Homemaker	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Home-based occupations	0.29(0.44)	0.514	-	-	0.28(0.59)	0.637	-	-
	Employee	0.86(0.95)	0.365	-	-	1.55(0.96)	0.106	-	-
	Retired	3.06(1.63)	0.062	-	-	1.55(1.64)	0.345	-	-
	Worker	-0.28(0.51)	0.581	-	-	0.63(0.49)	0.198	-	-
	Other	0.70(0.39)	0.073	-	-	0.73(0.49)	0.137	-	-
Spouse's occupation	Employee	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Worker	0.69(0.69)	0.317	-	-	−0.21(0.71)	0.766	-	-
	Self-employed	0.73(0.68)	0.286	-	-	0.15(0.70)	0.825	-	-
	Unemployed	0.25(0.93)	0.788	-	-	0.63(0.87)	0.470	-	-
	Retired	1.11(0.89)	0.210	-	-	0.14(1.07)	0.900	-	-
	Other	0.62(0.71)	0.387	-	-	0.15(0.74)	0.844	-	-
Childhood economic status	Low	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Moderate	0.26(0.33)	0.431	-	-	−0.36(0.67)	0.588	-	-
	High	0.24(0.53)	0.649	-	-	0.21(0.68)	0.757	-	-
Current economic status	Low	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Moderate	-0.99(0.66)	**0.134**	-1.05(0.82)	0.203	0.72(0.39)	**0.066**	1.51(0.39)	0.194
	High	0.50(0.49)	0.310	-	-	1.25(0.51)	**0.013**	1.51(0.97)	0.119
Housing status	Own home	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Rented	-0.11(0.24)	0.638	-	-	−0.41(0.32)	0.204	-	-
	Relative's home	-0.27(0.48)	0.576	-	-	−0.63(0.68)	0.349	-	-
Place of residence	Urban	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Rural	-0.16(0.23)	0.508	-	-	0.67(0.32)	**0.037**	0.51(0.39)	0.194
Intermediate social factors									
Pregnancy health literacy	-	-0.05(0.02)	**0.032**	-0.03(0.02)	0.144	−0.01(0.02)	0.657	-	-
Social support	-	-0.01(0.01)	0.169	-	-	−0.006(0.01)	0.532	-	-
Food insecurity	-	0.05(0.03)	**0.066**	0.01(0.04)	0.806	0.19(0.04)	**< 0.001**	0.19(0.05)	**< 0.001**
Substance abuse									
Addiction test result	Negative	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
	Positive	2.28(0.32)	**< 0.001**	2.07(0.37)	**< 0.001**	2.64(0.35)	**< 0.001**	2.17(0.42)	**< 0.001**

Discussion

The findings of this study revealed a noteworthy 7.2% prevalence of substance abuse among pregnant women in Neyshabur, with methadone and morphine being the most frequently reported substances. This prevalence was higher than the pooled estimate of 3.3% reported among pregnant women in Iran in a recent systematic review and meta-analysis (10). Globally, the reported prevalence of substance use during pregnancy varies substantially according to the assessment method, ranging from approximately 1.65% in self-reported studies to 12.28% in studies using toxicological testing (35).

Although direct comparisons should be made cautiously because of differences in population characteristics and definitions of substance use, the relatively high prevalence observed among pregnant women in the present study is notable. The higher prevalence compared with the general female population may partly reflect differences in the socioeconomic and demographic characteristics of the populations studied, as well as differences in the measurement and reporting of substance use.

Findings on the social determinants of health indicated that more than 80% of participants had low socioeconomic status, while most were housewives and had only primary or middle school education. Participants had a highly favorable level of maternal health literacy, whereas social support and food insecurity were at moderate levels. Maternal health literacy in the present study was higher than that reported in previous studies in Iran(36, 37). While a Nigerian study reported that more than one-third of participants had low maternal health literacy (38). However, the levels of social support and food insecurity observed in the present study were moderate and broadly comparable to those reported in other studies(39, 40).

In the present study, 13% experienced at least one adverse maternal outcome, with preterm birth (8.6%) being the most common. Similarly, Ragsdale et al. (2024) found that substance use disorder was associated with increased adverse pregnancy outcomes, particularly preterm birth (aOR = 1.65). Similarly, Young-Wolff et al. (2024) found that prenatal cannabis use was associated with increased risks of several adverse maternal outcomes, including gestational hypertension, preeclampsia, and placental abruption(41).Despite differences in study populations and designs, both studies highlight the association between substance use and adverse pregnancy outcomes.

Among individual and familial characteristics, chronic disease was significantly associated with adverse maternal outcomes and increased the likelihood of experiencing such outcomes. This finding is consistent with the results of Ojuwale et al. (2024) in Nigeria and Rostami et al. (2026) in Iran, both of which support the association between maternal chronic disease and an increased risk of adverse maternal outcomes (42, 43).

Among reproductive and obstetric characteristics, a history of miscarriage, a history of stillbirth, and complications during the current pregnancy were significant predictors of adverse maternal outcomes. These findings are consistent with the results of a systematic review and meta-analysis conducted across less-developed countries, which demonstrated that a history of stillbirth was associated with adverse pregnancy outcomes, including preterm birth and preeclampsia (44).

In the present study, structural and intermediate social determinants were not significantly associated with adverse maternal outcomes. This finding is consistent with the 2025 systematic review, which suggested that educational attainment alone may not independently predict adverse maternal outcomes (45). Similarly, a 2025 scoping review reported no significant association between food insecurity and adverse maternal outcomes(46). In contrast, Morgen et al. (2008), using a large national cohort in Denmark, reported that maternal education was the strongest predictor of preterm birth (47). This discrepancy may be attributable to differences in study design, outcome definitions, adjustment for potential confounders (e.g., prenatal care, BMI, and underlying medical conditions), and cultural and healthcare contexts.

However, after adjustment for other variables, the regression models showed that addiction was a strong and significant risk factor, substantially increasing the likelihood of adverse maternal outcomes. Similar findings were reported in previous studies(2, 13, 48, 49).

In the present study, maternal age was significantly associated with adverse fetal outcomes. This finding is in line with a previous study that reported a significant association between maternal age and low birth weight (50). Similar findings were reported by two other study that identified advanced maternal age as a risk factor for low birth weight (51, 52). However, evidence regarding this association is not consistent across settings. For example, Bhaskar et al. found no significant association between maternal age and low birth weight in Nepal (53). Differences in study populations, maternal characteristics, and contextual factors may partly explain these discrepant findings.

A history of stillbirth and complications during the current pregnancy were also significantly associated with adverse fetal outcomes in the present study. The association between a previous stillbirth and adverse fetal outcomes is supported by the previous study that similarly reported a significant association between a history of stillbirth and adverse fetal outcomes(54).

This study had several limitations. First, the cross-sectional design precludes establishing a causal relationship between the independent variables and pregnancy outcomes. Second, because the data were collected from a single center in eastern Iran, the findings may not be fully generalizable to other regions of the country, given potential cultural and structural differences. Finally, residual confounding cannot be ruled out, as certain potential confounders, such as lifestyle and genetic factors, were not assessed.

Conclusion

The findings indicate that substance use disorder was the strongest risk factor for adverse maternal and fetal outcomes. A history of stillbirth or miscarriage, complications during the current pregnancy, and chronic diseases were also important predictors, whereas socio-structural factors,

including education, occupation, and economic status, showed weaker associations in this population. These findings highlight the need for policymakers to prioritize comprehensive substance use screening and treatment, alongside enhanced preconception care for women at high risk. Healthcare professionals can further reduce adverse maternal outcomes through early identification and management of substance use disorders, closer monitoring of women with adverse obstetric histories, appropriate management of chronic diseases before pregnancy, and education and empowerment of women and their families.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Regional Ethics Committee for Biomedical Research of the Gonabad University of Medical Sciences (Code: IR.GMU.REC.1402.167). Written informed consent was obtained from all participants prior to data collection, and confidentiality and anonymity of participants' information were strictly maintained.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests

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Author Contribution

"Study concept and design: N. B, F.M, F.M, E.MK, and MGh. Data collection: F.M and MGh. Analysis and interpretation of data: F.M, F.M, and N.B. Drafting of the manuscript: F.M, F.M, and N.B. Critical revision of the manuscript for important intellectual content: All authors. Also, all authors read and approved the final manuscript."

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Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

References

1. Pearson TD, Bricault S, Lin YS, Barusso KE, Bodangi S, Wey HY. Preclinical PET imaging of the developing fetus during pregnancy: Current state and future potential. J Cereb Blood Flow Metabolism. 2025;45(9):1623–34.
2. Cherniak V, Turner S, Wyne A. Substance use disorder in pregnancy: A review. Can J Gen Intern Med. 2025;20(2):91–104.
3. Claudia B, Parodi MaríaV, Repetto CM, Contartese JésicaN, Taiman MaríaP, Osorio, Ignacio M. GalloRetrospective toxicological analysis of cocaine and cannabis use in postpartum women with social risk factors at a tertiary hospital (2020–2025). 2025. 2(2): 14–6.
4. Harris MTH, Laks J, Stahl N, Bagley SM, Saia K, Wechsberg WM. Gender Dynamics in Substance Use and Treatment: A Women's Focused Approach. Med Clin North Am. 2022;106(1):219–34.
5. Rockville (MD). Substance Abuse and Mental Health Services Administration; 2025 [cited 2026 Sep 10]. Available from: SAMHSA 2024 NSDUH Detailed Tables.
6. Lee RW, Lee KW, Tan KH. A Perinatal Review of Prevalence and Risk Factors for Substance Abuse Among Pregnant Women in Singapore. Cureus. 2025;17(11).
7. Galshi M, Bouzari ZS, Naimi Rad M, Yazdani S, Talebi S, Keramat A. Prevalence of substance abuse and pregnancy outcomes in pregnant women referred to Ayatollah Rouhani Hospital in Babol from 2017 to 2019 (a historical cohort study). Iran J Obstet Gynecol Infertility. 2022;25(4):43–50.
8. Tabatabaei SM, Behmanesh-Pour F, Salimi-Khorashad A, Zaboli M, Sargazi-Moakhar Z, Shaare-Mollashahi S. Substance Abuse and its Associated Factors among Pregnant Women: A Cross-Sectional Study in the Southeast of Iran. Addict Health. 2018;10(3):162–72.

9. Iranpour A, Kazemian E, Karamoozian A, Nakhaee N, Sharifi H, Fadakar MM. Prevalence of substance use during pregnancy and the related factors: A study from Southeast Iran. J Kerman Univ Med Sci. 2023;30(5):261–6.
10. Saeidi R, Gholami M. Substance abuse in pregnant mothers in Iran: a systematic review and meta-analysis. Tehran Univ Med J. 2025;83(6):404–9.
11. Lo JO, Shaw B, Robalino S, Ayers CK, Durbin S, Rushkin MC, et al. Cannabis use in pregnancy and neonatal outcomes: a systematic review and meta-analysis. Cannabis Cannabinoid Res. 2024;9(2):470–85.
12. Balaceanu M, Engel SM, Ramos AM. The Effect of Prenatal Substance Use and Maternal Parenting on Infant Reactivity and Regulation. Infancy. 2026;31(4):e70107.
13. Pinto SM, Dodd S, Walkinshaw SA, Siney C, Kakkar P, Mousa HA. Substance abuse during pregnancy: effect on pregnancy outcomes. Eur J Obstet Gynecol Reproductive Biology. 2010;150(2):137–41.
14. Bayih WA, Belay DM, Ayalew MY, Tassew MA, Chanie ES, Feleke DG et al. The effect of substance use during pregnancy on neonatal outcomes in Ethiopia: A systematic review and meta-analysis. Heliyon. 2021;7(4).
15. Doğan NN, Salihoğlu Ö. Prenatal Substance Abuse: a 1-Year Single-Center Experience at a Tertiary Neonatal Intensive Care Unit. Turkish J Pediatr Disease. 2024;18(1):7–12.
16. Sarfo JO, Opoku PN, Kwaw R, Miezah D, Dziwornu E, Sarfo JC. Maternal substance abuse prevalence and related neurodevelopmental outcomes: a scoping review. BMC Pregnancy Childbirth. 2025;26(1):81.
17. Wang E, Glazer KB, Howell EA, Janevic TM. Social determinants of pregnancy-related mortality and morbidity in the United States: a systematic review. Obstet Gynecol. 2020;135(4):896.
18. Neo DT, Desrosiers TA, Martin CL, Carmichael SL, Gucsavas-Calikoglu M, Conway KM, Evans SP, Feldkamp ML, Gilboa SM, Insaf TZ, Musfee FI, Shaw GM, Shumate CJ, Werler MM, Olshan AF. National Birth Defects Prevention Study. Neighborhood-level Socioeconomic Position During Early Pregnancy and Risk of Gastroschisis. Epidemiology. 2023;34(4):576–88.
19. Neerland C, Slaughter-Acey J, Behrens K, Claussen AM, Usset T, Bilal-Roby S, Bashir H, Westby A, Wagner B, McAlpine D, Dixon M. An evidence map for social and structural determinants for maternal morbidity and mortality: a systematic review. Obstet Gynecol. 2023;143(3):383.
20. World Health Organization. A Conceptual Framework for Action on the Social Determinants of Health, Social Determinants of Health Discussion Paper 2. avalable from: https://iris.who.int/bitstream/handle/10665/44489/9789241500852_eng.pdf?sequence=1. [site access: Feb 2, 2025].
21. Gómez CA, Kleinman DV, Pronk N, Gordon GL, Ochiai E, Blakey C, Johnson A, Brewer KH. Addressing health equity and social determinants of health through healthy people 2030. J public health Manage Pract. 2021;27(6):S249.
22. O'Donnell M, Nassar N, Leonard H, Hagan R, Mathews R, Patterson Y, et al. Increasing prevalence of neonatal withdrawal syndrome: Population study of maternal factors and child protection involvement. Pediatrics. 2009;123(4):e614–21.
23. Imaz ML, Navinés R, Gelabert E, Fonseca F, Gutierrez-Zotes A, Guillamat R, et al. Substance use during pregnancy and personality dimensions. Adicciones. 2020;0(0):1433.
24. Crisóstomo BD, Nascimento AS, Oliveira RA, Balsells MM, Ribeiro SG, Gadelha IP, Aquino PD. Social determinants of health and psychoactive drug use in pregnancy. Acta Paulista de Enfermagem. 2022;35:eAPE0340345.
25. Gheshlaghi F, Khezri E, Malekzadeh N. The prevalence of substance abuse and its relationship with demographic factors among pregnant women. J Isfahan Med School. 2021;39(617):167–73.
26. Garniasih D, Susanah S, Sribudiani Y, Hilmanto D. The incidence and mortality of childhood acute lymphoblastic leukemia in Indonesia: A systematic review and meta-analysis. PLoS ONE. 2022;17(6):e0269706.
27. Bennett DA. How can I deal with missing data in my study? Aust N Z J Public Health. 2001;25(5):464–9.
28. Mojoyinola JK. Influence of maternal health literacy on healthy pregnancy and pregnancy outcomes of women attending public hospitals in Ibadan, Oyo State, Nigeria. Afr Res Rev. 2011;5(3).
29. Kharazi SS, Peyman N, Esmaily H. An Evaluation of the Validity and Reliability of the Maternal Health Literacy and Pregnancy Outcome Questionnaire. J Health Syst Res. 2017;12(4):512–9.
30. Zimet GD, Dahlem NW, Zimet SG, Farley GK. The multidimensional scale of perceived social support. J Pers Assess. 1988;52(1):30–41.
31. Bahmard V, Bahri N, Mohammadzadeh F, Delshad A, Bahri N. Relationships Between Anxiety Induced by COVID-19 and Perceived Social Support among Iranian Pregnant Women. J Psychosom Obstet Gynecol. 2022;43(3):307–14.
32. Castell GS, Rodrigo CP, de la Cruz JN, Bartrina JA. Household food insecurity access scale (HFIAS). Nutr Hosp. 2015;31(3):272–8.
33. Salarkia N, Abdollahi M, Amini M, Eslami Amirabadi M. Validation and use of the HFIAS questionnaire for measuring household food insecurity in Varamin-2009. Iran J Endocrinol Metabolism. 2011;13(4):374–83.
34. Gholizadeh H, Rostamian Motlagh Z, Badsar M, Shams A. Culture and nutrition knowledge, and their relationship with food insecurity among rural households in Kermanshah County, Iran. J rural Res. 2017;8(1):54–67.
35. avella RA, DE Abreu VOM, Muccillo-Baisch AL, DA, Silva JÚnior FMR. Prevalence of Illicit Drug Use During Pregnancy: A Global Perspective. An Acad Bras Cienc. 2020;92(4):e20200302.
36. Ghotbizadeh F, Panahi Z, Tarafdari Manshadi A, Soltani S, Akbari R, Parsapur M. Maternal health literacy and pregnancy outcomes: does any association exist? J Obstet Gynecol cancer Res. 2022;8(1):68–75.

37. Tavananezhad N, Bolbanabad AM, Ghelichkhani F, Effati-Daryani F, Mirghafourvand M. The relationship between health literacy and empowerment in pregnant women: a cross-sectional study. BMC Pregnancy Childbirth. 2022;22(1):351.
38. Bello C, Esan D, Akerele S, Fadare R. Maternal health literacy, utilisation of maternal healthcare services and pregnancy outcomes among newly delivered mothers: A cross-sectional study in Nigeria. Public Health Pract. 2022;3:100266.
39. Carandang RR, Lewis JB, Masters C, Ickovics JR, Cunningham SD. Influence of resilience and social support on the association between food insecurity and depressive symptoms during pregnancy: A moderated mediation model. J Affect Disord. 2025;383:435–42.
40. Bahmard V, Bahri N, Mohammadzadeh F, Delshad A, Bahri N. Relationships Between Anxiety Induced by COVID-19 and Perceived Social Support among Iranian Pregnant Women. J Psychosom Obstet Gynecol. 2022;43(3):307–14.
41. Young-Wolff KC, Adams SR, Alexeeff SE, Zhu Y, Chojolan E, Slama NE, Does MB, Silver LD, Ansley D, Castellanos CL, Avalos LA. Prenatal cannabis use and maternal pregnancy outcomes. JAMA Intern Med. 2024;184(9):1083–93.
42. Ojewale L, Olabode I. Illness pattern and Pregnancy Outcomes among Women with Chronic Medical Conditions in a Hospital in Ibadan. Nigerian Health J. 2024;24(3):1505–13.
43. Rostami-Maskopaee F, Asadi-Aliabadi M, Moosazadeh M, Jamkhane AE, Rezai MS. The First 1000 Critical Days: Determinants of Adverse Birth Outcomes in the Sari Birth Cohort, Iran. Int J Prev Med. 2026;17:35.
44. Kassa BG, Parry YK, Wassie MM, Lines LE. Association between previous perinatal death and subsequent pregnancy outcomes in Low-and Middle-Income Countries: A systematic review and meta-analysis. Midwifery. 2026;154:104696.
45. Kinshella MW, Pickerill K, Prasad S, Campbell O, Devji J, Lopes LV, Balleny R, Elawad T, Craik R, Volvert ML, Mistry HD, Blencowe H, Filippi V, von Dadelszen P, Magee LA, Vidler M, PRECISE Network. Towards the Development of a Conceptual Framework of the Determinants of Pre-Eclampsia: A Hierarchical Systematic Review of Social Determinants. BJOG. 2025. 10.1111/1471-0528.18082. .
46. Kinsey EW, Caceres OM, Posner HE, Hinkle SN. Food insecurity during pregnancy and associated perinatal outcomes: a scoping review. Epidemiol Rev. 2025;47(1):mxaf001.
47. Morgen CS, Bjørk C, Andersen PK, Mortensen LH, Nybo Andersen A-M. Socioeconomic position and the risk of preterm birth—a study within the Danish National Birth Cohort. Int J Epidemiol. 2008;37(5):1109–20.
48. Keller JM, Al-Hammadi N, Bass S, Chavan NR. Substance use disorder and severe maternal morbidity: is there a differential impact? Am J Obstet Gynecol MFM. 2025;7(1):101544.
49. Board A, D'Angelo DV, von Essen BS, Denny CH, Miele K, Dunkley J, Baillieu R, Kim SY. Polysubstance use during pregnancy: The importance of screening, patient education, and integrating a harm reduction perspective. Drug Alcohol Depend. 2023;247:109872.
50. Putri SA, Herdiman J. The Relationship Between Maternal Age And The Incidence Of Low Birth Weight Babies. Jurnal EduHealth. 2023;14(03):1358–62.
51. Rodríguez-Fernández A, Sanhueza-Riquelme X, Parra-Flores J, Marrodán Serrano MD, Maury-Sintjago E. Association between maternal factors, preterm birth, and low birth weight of Chilean singletons. 2022.
52. Aradhya S, Tegunimataka A, Kravdal Ø, Martikainen P, Myrskylä M, Barclay K, et al. Maternal age and the risk of low birthweight and pre-term delivery: a pan-Nordic comparison. Int J Epidemiol. 2023;52(1):156–64.
53. Bhaskar RK, Deo KK, Neupane U, Chaudhary Bhaskar S, Yadav BK, Pokharel HP, et al. A Case Control Study on Risk Factors Associated with Low Birth Weight Babies in Eastern Nepal. Int J Pediatr. 2015;2015:807373.
54. Mengistu S, Debella A, Mulatu T, Mesfin F, Danusa KT, Dheresa M. Stillbirth and associated factors among women who gave birth at Hiwot Fana specialized university hospital, Harar, Eastern Ethiopia. Front Pead. 2022;10:820308.