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**ORIGINAL ARTICLE**

# Maternal Risk Factors for Low Birthweight Neonates in Sana'a City Yemen: A Case-Control Study

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## ABSTRACT

**Background**: Low birth weight (LBW) describes neonates weighing less than 2500 g at birth and is a common obstetric presentation. Therefore, this study determined the risk factors associated with LBW in Sana'a city, Yemen, with a focus on khat chewing during pregnancy.

**Methods:** This case-control study recruited 35 mothers with LBW neonates as cases and 105 mothers with normal birthweight neonates as controls. Data about sociodemographic characteristics, maternal habits, and obstetric characteristics were collected using a pre-designed questionnaire. The association between independent variables and LBW was tested at *P*-value <0.05.

**Results:** Consanguinity (OR = 3.7, 95% CI: 1.6–8.8; *P* = 0.005), smoking (OR = 2.6, 95% CI: 1.0–6.6; *P* = 0.038), history of LBW (OR = 5.0, 95% CI: 2.0–12.8; *P* <0.001) and family history of LBW (OR = 3.7, 95% CI: 1.6–8.8; *P* = 0.004) were significantly associated with LBW. However, LBW was not associated with sociodemographic characteristics, khat chewing, or other obstetric characteristics.

**Conclusions:** Consanguinity and smoking are predictors of LBW neonates in Sana'a city. However, khat chewing is not associated with LBW. On the other hand, no significant association exists between LBW and the obstetric characteristics of parity, birth spacing, antenatal care, or frequency of antenatal visits. Yet, a history of maternal LBW and a family history of LBW is associated with LBW. Further large-scale studies are recommended to explo re the risk factors associated with LBW at the community level.

**Keywords**: Khat chewing; Low birthweight; Neonate; Yemen

## INTRODUCTION

Birthweight is an indicator of neonatal well-being, and normal birthweight (NBW) ranges from 2990 to 3990 g. However, neonates with a birth weight of less than 2500 g are considered low birthweight (LBW). Intrauterine growth restriction (also termed intrauterine growth retardation) (IUGR) is a major cause of morbidity and mortality among neonates which may affect the physical and mental development during early childhood [1, 2]. IUGR refers to a less-than-normal rate of fetal growth in relation to the gender and race of the fetus [1-3]. Its incidence ranges between 3% and 7% of the total population worldwide [4, 5], being six times higher in underdeveloped and developing countries compared to developed countries and can be much higher in lower- and middle-income countries because of home delivery and lack of birth records [6].IUGR commonly results from maternal, placental, fetal, and genetic factors, or from a combination of any of these factors [6]. Birth outcomes are affected by several obstetric factors such as the mother's age, birth spacing, maternal nutrition, infections, and chronic diseases such as hypertension, cardiovascular diseases, collagen vascular diseases, and renal diseases [2, 6, 7]. In addition, maternal behavioral habits such as active and passive tobacco consumption [4, 7] and excessive coffee consumption during pregnancy [4, 7] as well as exposure to teratogens and radiations [7]. Moreover, the risk factors for adverse birth outcomes include increased overtime work during pregnancy long-standing times while pregnant [4]. Deficiency in the placental supply of nutrients to the fetus also leads to IUGR [6], and hence to LBW, as occurring in placental malformations [7]. Various maternal, fetal, and placental gene polymorphisms have also been implicated as a cause of IUGR [6].The leaves of the khat plant (*Catha edulis* Forsk) are chewed for psychosomatic stimulation by people of Yemen, Ethiopia, Kenya, and other east African countries

[8-10]. Khat chewing is popular among Yemeni women, even during pregnancy and lactation as revealed by a national survey in 1997 [10]. Experimental studies showed that the administration of khat extract to pregnant rats and Guinea pigs can lead to retarded growth of the offspring rats [9, 11]. However, studies on humans are few. In this regard, khat chewing during pregnancy has been found to significantly reduce birth weight in full-term infants [12, 13]. Khat chewing during pregnancy was found to be significantly associated with adverse maternal and fetal outcomes, including LBW [14]. Therefore, this study was conducted to determine the risk factors associated with LBW neonates in Sana'a city, Yemen, with a focus on khat chewing during pregnancy.

## METHODS

### *Study design, setting, and population*

A case-control study was conducted in three hospitals; namely, Al-Jomhouri Teaching Hospital, Al-Thawra Modern General Hospital, and University of Science and Technology Hospital, in Sana'a city from January to March 2018. It recruited 35 women with LBW neonates as cases and 105 women with NBW neonates as controls. Women were included if their neonates were weighed within 24 hours of delivery and if both parents agreed to participate in this study. All neonates born in Al-Jomhouri Teaching Hospital, Al-Thawra Modern General Hospital, and University of Science and Technology Hospital, in Sana'a city during the period from January to March 2018 with apparently healthy mothers were included in our study. On the other hand, mothers with known acute or chronic diseases, complicated pregnancies, dystonic labor, neonates with congenital malformations, preterm babies, and stillbirths were excluded from our study. Written informed consent was obtained from all participants. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

### *Data collection*

After weighing neonates with a digital neonatal balance (newborns were grouped into a case group; if birthweight was less than 2500g and a control group; if birthweight was more than or equal to 2500g), data were collected using a pre-designed structural questionnaire. The questionnaire includes four sections: The first section was about sociodemographic characteristics (age, education, place of residency, employment, income, age at marriage, and consanguinity); the second section included questions about the habits of khat chewing (chewing khat during pregnancy, frequency, and duration) and smoking; the third section included questions about the obstetric history (parity, previous LBW, birth spacing and family history of LBW).

## STATISTICAL ANALYSIS

Data were analyzed using IBM SPSS Statistics for Windows, version 21.0 (IBM Corp., Armonk, NY, USA). Differences and associations between categorical variables were tested for statistical significance using the chi-square or Fisher's exact test. *P*-value <0.05 was considered statistically significant.

## RESULTS

### *Association of sociodemographic characteristics and maternal habits with LBW neonates*

Table (1) shows that the mean age of mothers at the time of the study was almost equal for both cases and controls (27.6 ± 7.3 *vs.* 27.5 ± 6.1 years, respectively), where the majority of mothers were younger than 30 years (68.6% *vs.* 67.6%, respectively). On the other hand, 42.9% of cases married at an age below 18 years compared to controls (28.6%), with a slightly earlier age of marriage (18.4 years) for cases compared to controls (19.8 years). The residence of mothers in both arms of the study was comparably similar, were 71.4% and 69.5% of cases and controls, respectively, were urban residents. The majority of both cases and controls were literate (85.7% *vs.* 79.9%, respectively), unemployed (94.3% *vs.* 83.8%, respectively) and belonging to families with a monthly income of ≤50,000 Yemeni rials (71.4% *vs.* 68.5%, respectively). Consanguinity (OR = 3.7, 95% CI: 1.6–8.8; *P* = 0.005) and smoking (OR = 2.6, 95% CI: 1.0–6.6; *P* = 0.038) were significantly associated with LBW neonates in Sana'a. In contrast, no significant association was found between the delivery of LBW neonates and the maternal age at delivery (*P* = 1.000), maternal age at marriage (*P* = 0.117), residence (*P* = 0.831), educational status (*P* = 0.616), employment status (*P* = 0.200), or monthly family income of mothers (*P* = 0.834). On the other hand, LBW was not significantly associated with the maternal habit of khat chewing during pregnancy (*P* = 0.552), frequency of chewing (*P* = 0.128), frequency of daily chewing sessions (*P* = 0.337), or length of chewing sessions (*P* = 0.648).

### *Association of obstetric characteristics with LBW neonates*

Table (2) shows that past history of LBW (OR = 5.0, 95% CI: 2.0–12.8; *P* <0.001) and family history of LBW (OR = 3.7, 95% CI: 1.6–8.8; *P* = 0.004) were significantly associated with the delivery of LBW neonates among pregnant women in Sana'a. In contrast, no significant association was found between LBW and parity (*P* = 0.395), birth spacing (*P* = 0.648), antenatal

care ($P$ = 0.055), or frequency of antenatal visits
($P$ = 0.783).

**Table 1:** Sociodemographic characteristics of participant mothers with LBW neonates in Sana'a city, Yemen (2018)

| Characteristics | Cases (N =35) | | Controls (N = 105) | |
|---|---|---|---|---|
| | *N* | (%) | *N* | (%) |
| **Age (years)** | | | | |
| Mean ± SD: | 27.6 ± 7.3 | | 27.5 ± 6.1 | |
| < 30 | 24 | (68.6) | 71 | (67.6) |
| ≥ 30 | 11 | (31.4) | 34 | (32.4) |
| **Age at marriage (years)** | | | | |
| Mean ± SD: | 18.4 ± 3.3 | | 19.8 ± 4.1 | |
| < 18 | 15 | (42.9) | 30 | (28.6) |
| ≥ 18 | 20 | (57.1) | 75 | (71.4) |
| **Residence** | | | | |
| Urban | 25 | (71.4) | 73 | (69.5) |
| Rural | 10 | (28.6) | 32 | (30.5) |
| **Educational status** | | | | |
| Illiterate | 5 | (14.3) | 21 | (20.0) |
| Literate | 30 | (85.7) | 84 | (79.9) |
| **Employment status** | | | | |
| Unemployed | 33 | (94.3) | 88 | (83.8) |
| Employed | 2 | (5.7) | 17 | (16.2) |
| **Monthly family income (Yemeni rials)** | | | | |
| ≤ 50,000 | 25 | (71.4) | 72 | (68.5) |
| > 50,000 | 10 | (28.6) | 33 | (31.4) |

**Table 2:** Association of sociodemographic characteristics and maternal habits during pregnancy with LBW neonates in Sana'a city, Yemen (2018)

| Variable | Cases | | Controls | | OR | (95% CI) | *P*-value |
|---|---|---|---|---|---|---|---|
| | ***n*** | **(%)** | ***n*** | **(%)** | | | |
| **Maternal age at delivery (years)** | | | | | | | |
| < 30 | 24 | (68.6) | 71 | (67.6) | 1.8 | (0.8–4.1) | 1.000 |
| ≥ 30 | 11 | (31.4) | 34 | (32.4) | | | |
| **Maternal age at marriage (years)** | | | | | | | |
| < 18 | 15 | (42.9) | 30 | (28.6) | 1.8 | (0.8–4.1) | 0.117 |
| ≥ 18 | 20 | (57.1) | 75 | (71.4) | | | |
| **Residence** | | | | | | | |
| Urban | 25 | (71.4) | 73 | (69.5) | 1.1 | (0.5–2.5) | 0.831 |
| Rural | 10 | (28.6) | 32 | (30.5) | | | |
| **Educational status** | | | | | | | |
| Illiterate | 5 | (14.3) | 21 | (20.0) | 0.7 | (0.2–1.9) | 0.616 |
| Literate | 30 | (85.7) | 84 | (79.9) | | | |
| **Employment status** | | | | | | | |
| Unemployed | 33 | (94.3) | 88 | (83.8) | 3.2 | (0.7–14.6) | 0.200 |
| Employed | 2 | (5.7) | 17 | (16.2) | | | |
| **Monthly family income (Yemeni rials)** | | | | | | | |
| > 50.000 | 10 | (28.6) | 33 | (31.4) | 0.9 | (0.4–2.0) | 0.834 |
| ≤ 50.000 | 25 | (71.4) | 72 | (68.5) | | | |
| **Consanguinity** | | | | | | | |
| Yes | 14 | (40) | 16 | (15.2) | 3.7 | (1.6–8.8) | 0.005 |

| Variable | Cases | | Controls | | OR | (95% CI) | *P*-value |
|---|---|---|---|---|---|---|---|
| | *n* | (%) | *n* | (%) | | | |
| No | 21 | (60) | 89 | (84.7) | | | |
| **Khat chewing during pregnancy** | | | | | | | |
| Yes | 16 | (45.7) | 13 | (40.0) | 1.3 | (0.9–2.7) | 0.552 |
| No | 19 | (54.3) | 63 | (60.0) | | | |
| **Frequency of khat chewing during pregnancy** | | | | | | | |
| Occasional | 9 | (56.3) | 43 | (30.9) | 0.9 | (0.3–2.6) | 0.128 |
| Habitual | 7 | (43.7) | 29 | (69.1) | | | |
| **Frequency of khat sessions/day** | | | | | | | |
| More than once | 3 | (16.7) | 3 | (6.5) | 2.8 | (0.5–15.4) | 0.337 |
| Once | 15 | (83.3) | 42 | (93.5) | | | |
| **Length of khat chewing session (hours)** | | | | | | | |
| ≥2 | 17 | (94.4) | 44 | (95.7) | 0.8 | (0.1–9.0) | 0.648 |
| <2 | 1 | (5.5) | 2 | (4.3) | | | |
| **Smoking** | | | | | | | |
| Yes | 10 | (28.6) | 14 | (13.3) | 2.6 | (1.1–6.6) | 0.038 |
| No | 25 | (71.4) | 91 | (86.7) | | | |

LBW, low birthweight; OR, odds ratio; CI, confidence interval.

**Table 3:** Association of mothers' obstetric characteristics with LBW neonates in Sana'a city, Yemen (2018)

| Variable | Cases (N = 35) | | Controls (N = 105) | | OR | (95% CI) | *P*-value |
|---|---|---|---|---|---|---|---|
| | *n* | (%) | *n* | (%) | | | |
| **Parity** | | | | | | | |
| ≤ 3 | 23 | (65.7) | 77 | (73.3) | 0.7 | (0.3–1.6) | 0.395 |
| > 3 | 12 | (34.3) | 28 | (26.7) | | | |
| **Birth spacing (years)** | | | | | | | |
| ≤ 2 | 15 | (42.8) | 40 | (38) | 1.1 | (0.5–2.8) | 0.648 |
| > 2 | 11 | (42.3) | 33 | (45.2) | | | |
| **Antenatal care** | | | | | | | |
| Yes | 26 | (74.3) | 93 | (88.6) | 2.7 | (1.0–7.1) | 0.055 |
| No | 9 | (25.7) | 12 | (11.4) | | | |
| **Frequency of antenatal visits** | | | | | | | |
| ≤ 3 | 7 | (28.0) | 29 | (30.9) | 0.9 | (0.3–2.3) | 0.783 |
| > 3 | 18 | (72.0) | 65 | (69.1) | | | |
| **Past history of LBW** | | | | | | | |
| Yes | 13 | (37.1) | 11 | (10.5) | 5.0 | (2.0–12.8) | <0.001 |
| No | 22 | (62.9) | 94 | (89.5) | | | |
| **Family history of LBW** | | | | | | | |
| Yes | 14 | (40.0) | 16 | (15.2) | 3.7 | (1.6–8.8) | 0.004 |
| No | 21 | (60.0) | 89 | (84.8) | | | |

LBW; low birthweight; OR, odds ratio; CI, confidence interval.

## DISCUSSION

Khat chewing is a popular social and cultural custom in Yemeni society and is a fundamental component of weddings and social gatherings. It is commonly practiced on a daily basis in many parts of the country for stimulant and euphoric properties, with a large proportion of women consuming it in urban and rural areas [12]. The custom of khat chewing in Yemen is dated back over 700 years, becoming an acceptable habit among women and children with the failure of all attempts to curb it [10]. Nevertheless, the effects of chewing khat on maternal and fetal outcomes are questionable [10, 14]. Birth weight is the most

sensitive indicator of intrauterine fetal insults resulting from different maternal environmental exposures. LBW can result from several factors, including antenatal substance use [15]. The WHO Expert Committee on Drug Dependence (ECDD) declared that substance use during pregnancy may have adverse obstetric effects such as LBW and stillbirths [15, 16].

The present study revealed that consanguinity was significantly associated with the delivery of LBW neonates by Yemeni pregnant women in Sana'a city, where mothers with LBW neonates were 3.7-fold more likely to have consanguineous marriages compared to those with NBW neonates. Consanguinity has been shown to significantly increase the risk for LBW as evidenced by a meta-analysis [17]. This highlights the possible role of marriage between relatives in Yemen in the delivery of LBW neonates. It is noteworthy that the incidence of consanguinity, particularly first-cousin marriage, is relatively high in Sana'a city as a result of inherent social and cultural beliefs [18]. In line with the finding of the present study, consanguinity was found to significantly reduce birthweight for gestational age among Lebanese newborns, with no significant difference in relation to the degree of consanguinity [19].

The lack of significant association between early maternal age of marriage (below 18 years) and the delivery of LBW neonates in the present study are consistent with reports from Pakistan and India, where maternal child marriage was not significantly associated with LBW infants [20, 21]. In contrast to the present study, the maternal age of pregnant women aged 17 years or younger and admitted to Al-Thawrah Hospital in Sana'a was significantly associated with a higher frequency of LBW compared to controls [22]. On the other hand, maternal age at delivery was not found to be associated with LBW in the present study. Unlike the present study, younger maternal age was found to be a significant predictor of LBW in Malawi [23]. Although educated women are more aware of the nutrition and care of themselves during pregnancy, the present study did not find a significant association between educational status and LBW. Moreover, employment status or monthly family income were not significant predictors of having LBW neonates in the present study. In contrast to the present study, educated mothers were found to have newborns with significantly higher birthweight means compared to uneducated mothers in a one-year study conducted at Kuwait University Hospital in Sana'a [24]. The illiteracy of mothers was also found to be significantly associated with LBW in Ethiopia [25]. In agreement with the present study, LBW showed no significant association with occupational status or family income among Ethiopian women [25]. In Iran, mothers with primary and secondary education were found to be more likely to have LBW infants compared to those with higher education levels [26].

Several adverse maternal behaviors can affect the birth weight of neonates, including khat chewing and smoking. However, only smoking was significantly associated with having LBW neonates among pregnant women in Sana'a. In this respect, mothers with LBW neonates were 2.6-fold more likely to be smokers compared to mothers with NBW neonates. This finding is consistent with that recently reported for newborns in a tertiary care hospital in Sana'a [27], where the smoking of mothers was a significant risk factor for LBW. Moreover, maternal smoking has been reported as a significant predictor of LBW elsewhere [28, 29]. In contrast, an earlier study did not find a significant association between smoking and LBW in full-term Yemeni infants [12]. The negative impact of tobacco smoking on birthweight has been evidenced in the literature as a risk factor for IUGR, and hence, LBW [4, 5, 7, 27]. One possible explanation is that smoking reduces uterine blood flow, which limits fetal oxygenation and attenuates growth [2].

Although khat can lower the appetite and have vasoconstrictive effects on the placental blood vessels [25], no significant association was found between khat chewing and LBW neonates in the present study. This finding is contradictory to that reported earlier for LBW in Yemen [12, 14, 24, 27] and Ethiopia [13, 15, 30]. Moreover, the frequency, pattern, and length of khat sessions showed no association with LBW in the present study. The lack of association in the present study could be attributed to other factors that have to be investigated further such as the number of khat leaves chewed, which may have a dose-response effect on the birth outcomes. The number of births and the interval between births had no relation to the birthweight of neonates in the present study, where parity and birth spacing were not significant predictors of LBW. A recent study among newborns at a tertiary care hospital in Sana'a showed that a birth interval of fewer than two years, but not parity, was significantly associated with LBW [27]. Increasing parity was found to be associated with improvement in birthweight of

newborns at Kuwait University Hospital in Sana'a [24], which was explained by the increasing knowledge of mothers from previous pregnancies. In contrast, a decrease in parity was found to be significantly associated with LBW newborns in Ethiopia and Iran [13, 25, 26]. In Malawi, women with previous deliveries were found to be significantly less likely to have an LBW baby [23].Although antenatal care is a critical determinant of birthweight, its association with LBW showed borderline significance while the frequency of antenatal visits was not significantly associated with LBW in the present study. Similarly, no significant association was found between the number of antenatal visits and LBW at Al-Thawrah Hospital in Sana'a [27].

This study is limited by being hospital-based besides the small sample size of the cases recruited, probably making its findings not generalizable at the community level. However, it gives insights into the risk factors associated with LBW.

## CONCLUSIONS

Consanguinity and smoking are preventable predictors of LBW neonates in Sana'a city. However, khat chewing is not associated with LBW. On the other hand, no significant association exists between LBW and the obstetric characteristics of parity, birth spacing, antenatal care, or frequency of antenatal visits. Yet, the history of LBW among mothers and the family history of LBW is associated with LBW. Further large-scale studies to explore the risk factors, particularly khat chewing, associated with LBW at the community level are recommended.

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