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- 1 Relationship between *Mollicutes* and spontaneous abortion: An epidemiological analysis

Silva Oliveira MT, Oliveira CNT, da Silva LSC, Braga Martins Oliveira H, Sousa Freire R, Marques LM, Santos MLC, de Melo FF, Souza CL, Oliveira MV

ABOUT COVER

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Basic Study

Relationship between *Mollicutes* and spontaneous abortion: An epidemiological analysis

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Abstract

BACKGROUND

Abortion is of great importance in public health, as it is among the main causes of maternal morbidity and mortality. In addition to sociodemographic- and lifestyle-related factors, studies have associated infections of the genital tract with higher rates of abortion. Therefore, the exacerbated presence and rise of *Mollicutes* in the genitourinary tract may be related to higher rates of abortion.

AIM

To perform an epidemiological analysis of women who had spontaneous abortions and placental colonization by *Mollicutes* in a maternity hospital.

METHODS

This cross-sectional study involved the collection of data and biological material from women hospitalized due to spontaneous abortion or term delivery. The sample consisted of 89 women who miscarried and 20 women who had full term pregnancy. Data collection was carried out in three stages: (1) Conducting research on the information and clinical data in medical records of patients hospitalized due to abortion; (2) Application of a semi-structured questionnaire to identify the patient's epidemiological profile and (3) Collection of placental tissue. Placental samples were collected after the curettage procedure (abortion) and after placental expulsion (delivery), both performed by an obstetrician. Microbial identification in the fragments was performed by real-time polymerase chain

associated with the contributions by any of the senior authors or coauthors to this manuscript.

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reaction. In this study, the following explanatory variables were considered: (1) Sociodemographic variables; (2) Variables related to access to health services; (3) Variables related to lifestyle; and (4) Variables related to sexual and reproductive health, all of which were used to perform descriptive, univariate and multivariate analyses.

RESULTS

In the final model, placental colonization by *Mollicutes* was independently associated with the variables age [odds ratio (OR) = 7.55; CI: 2.37-24.03] and menarche (OR = 3.43; CI: 1.03-11.44). In this investigation, the prevalence of *Mollicutes* colonization by at least one of the following three species: *Mycoplasma hominis*, *Ureaplasma urealyticum*, *Ureaplasma parvum* in women who had spontaneous abortion was 73.0%. When comparing colonization between the two groups of participating women, there was an 8.12-fold risk of placental colonization by at least one *Mollicutes* species in the women who had an abortion, compared to those who completed pregnancy. The final multivariate analysis model revealed a statistically significant association between placental colonization by *Mollicutes* in abortion with the following variables: age, as women up to 29 years old had a 7.55-fold risk of spontaneous abortion, compared to those who were older than 29 years; menarche, where women who had menarche up to 13 years old had a 3.43-fold risk of miscarriage compared to those who had menarche over 13 years old; and a change in eating habits, after the discovery of pregnancy, was a protective factor (OR = 0.16).

CONCLUSION

These findings revealed a positive association between spontaneous abortion and placental colonization by *Mollicutes*. This indicates the need for further investigation of this issue, to guide decision-making for the prevention of abortion.

Key Words: Miscarriage; Epidemiology; *Mollicutes*; Primary prevention

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Core Tip: This study analyzed the association between spontaneous abortion and placental colonization by *Mollicutes* using a cross-sectional design, which involved the collection of data and biological material from women hospitalized due to spontaneous abortion or term delivery. Microbial identification in biological samples was performed by real-time polymerase chain reaction and the collected data were used to perform descriptive, univariate and multivariate analyses. The prevalence of *Mollicutes* among women who had spontaneous abortion was 73.0% and in women who had an abortion, an 8.12-fold risk of placental colonization by at least one species of *Mollicutes* was observed, compared to those who completed pregnancy.

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INTRODUCTION

Abortion is considered the early termination of pregnancy at less than 22 wk and a fetus weighing less than 500 g. Approximately 10% to 15% of abortions occur spontaneously and mostly with an undetermined cause^[1,2]. Abortion is of great importance in public health, as it is among the main causes of maternal morbidity and mortality, especially in developing countries such as Brazil^[3].

According to the World Health Organization, each year, approximately 500 thousand women die from causes related to pregnancy, with 98% of cases occurring in developing countries. Of these deaths, 15% is associated with abortion complications^[4]. A global study revealed that in the period from 2010 to 2014, 25% of pregnancies worldwide resulted in abortion^[5].

Studies have associated sociodemographic factors (such as age, marital status, social context, socioeconomic conditions, and education) and factors related to lifestyle (such as alcohol consumption, smoking, pre-gestational nutritional status, reproductive history, environmental and occupational exposure of woman) with spontaneous abortion^[6-9].

Another important clinical aspect in pregnant women, is infections of the genital tract due to placental colonization with microorganisms related to bacterial vaginosis such as *Gardnerella vaginalis*, *Mollicutes* [*Mycoplasma hominis* (*M. hominis*), *Ureaplasma urealyticum* (*U. urealyticum*), *Ureaplasma parvum* (*U. parvum*)], *Mobiluncus spp*, *Chlamydia trachomatis*, among others^[2,10] as a possible cause of spontaneous abortion.

Mollicutes constitute a class of bacteria that differ from the other bacteria as they do not have a cell wall. The genera of interest in this study are *Mycoplasma* and *Ureaplasma*. The former are important opportunistic pathogens that colonize the male and female urogenital tract, and are responsible for triggering various pathologies including spontaneous abortion^[11]. *Ureaplasma* species are one of the main pathogens associated with genital infection, for example non-gonococcal urethritis in men and, in women, gestational complications such as premature birth and abortion, among others^[12].

The presence of *Mollicutes* in the genitourinary tract and its pathogenic potential is related to age, hormones, sexual activity, pregnancies, low socioeconomic status, smoking, use of vaginal showers and the use of oral contraceptives^[13]. The diagnosis of *Mollicutes* infection is quite difficult as they have low biosynthetic activity and require complex culture media, making the diagnosis using techniques such as Gram staining, complicated. They can also be diagnosed by immunoenzymatic reactions and by molecular biology, the latter being considered the gold standard for diagnosis^[14].

In pregnant women with modification of the vaginal microbiota, a reduction in *Lactobacillus* species is frequently found, triggering an increase in vaginal pH^[15]. As a result, changes occur in the human vaginal microbiome, which contains a varied number of bacterial species, including members of the *Mollicutes* class, which may find conditions which allow entry into the uterine cavity^[16]. In the uterus, they may be able to induce an immune response that can lead to excessive inflammation and consequently damage and death to the cellular components of the placental and fetal unit^[17].

Thus, in the present study we analyzed the association between spontaneous abortion and placental colonization by *Mollicutes*, in order to provide evidence capable of contributing to reduced health costs. In addition, the study of spontaneous abortion in women with placental colonization by *Mollicutes* has been little explored and may encourage further studies on this issue, thus increasing our understanding and management of spontaneous abortion. Therefore, we performed an epidemiological analysis of women treated for spontaneous abortion with placental colonization by *Mollicutes* in a maternity hospital in southwest Bahia, Brazil.

MATERIALS AND METHODS

This is a cross-sectional study, derived from a larger project, entitled "Evaluation of the participation of *Mollicutes* and other microorganisms of genital interest in the etiopathogenesis of spontaneous abortions". The present study aimed to detect *Mollicutes* and other microorganisms of genital interest in the placental biopsy of women who underwent spontaneous abortion, to assess their probable relationship in etiopathogenesis. It involved the collection of data and biological material from two groups: patients hospitalized due to spontaneous abortion and patients who had term delivery and was carried out by researchers from the Universidade Federal da Bahia and the Universidade Estadual de Santa Cruz.

The main objective of the present investigation was to determine the association between patients hospitalized due to spontaneous abortion and placental colonization by *Mollicutes*. For the purpose of comparison and verification of this association, we assessed the prevalence of placental colonization by *Mollicutes* from the group of women who had term pregnancy.

The study was carried out in a public hospital, in a maternal and child health care

unit for the municipality of Vitória da Conquista, Bahia, Brazil and the southwestern macro-region of the state of Bahia, Brazil. Vitória da Conquista it is the third largest city in Bahia, with a total population of 348718 inhabitants^[18].

The participants were women aged 18 years or older, hospitalized due to spontaneous abortion, with a gestational age greater than or equal to 8 wk and less than 22 wk and a fetus weighing less than 500 g. In addition, a group of women who underwent vaginal delivery at term (gestational age between 38 and 42 wk), who voluntarily agreed to participate in the study after being approached by the researchers was also included.

The study excluded women who used antibiotics less than two weeks after the abortion occurred. Also excluded were those with confirmed immunodeficiency, and chronic diseases previously diagnosed (hypertension, diabetes, endocrine disorders) and a history of recurrent abortions due to anatomical abnormalities and/or congenital malformation.

In this study the sample consisted of 89 women who miscarried and were treated between July 2017 and August 2018 and 20 women who had full term pregnancy at the hospital.

Data collection took place in three stages, which are shown in **Figure 1**. The first stage involved the collection of information and clinical data from the medical records of the patients hospitalized due to abortion. The second stage was the application of a semi-structured questionnaire in order to identify the patient's epidemiological profile, divided into modules, as a result of the adaptation of the National Health Survey, and the instrument used in the study by Campos *et al.*^[19]. The third stage consisted of collecting placental tissue^[20]. Placental samples were collected after a curettage procedure using a sterile speculum performed by an obstetrician. The fragment was stored in a transport medium for *Mycoplasma* and transported in thermal boxes to the Microbiology and Immunology laboratory of the Instituto Multidisciplinar em Saúde, at the Universidade Federal da Bahia. For microbial identification of placental tissue, genomic deoxyribonucleic acid was initially extracted using the Invitrogen Purelink™ Genomic deoxyribonucleic acid Kit (Invitrogen, Waltham, MA, United States). Subsequently, real-time polymerase chain reaction was performed using StepOne Plus (Life Technologies) with a final volume of 25 µL and the use of Master Mix (Thermo Fisher Scientific, Waltham, MA, United States). To identify the *Mollicutes* species, TaqMan probes were used, following the basic amplification protocol for each species. The studied species were: *M. hominis*, *U. urealyticum* and *U. parvum*.

The identification of placental *Mollicutes* in patients with abortion constituted the outcome variable of this study. The following explanatory variables were considered: (1) Sociodemographic variables: Age group, income, marital status, education, and skin color; (2) Variables related to access to health services: Prenatal consultations; (3) Variables related to lifestyle: Type of food consumed, physical activity, alcohol and tobacco use; and (4) Variables related to sexual and reproductive health: Historical existence of sexually transmitted infection, presence of genital alterations (ulcers, blisters, lumps, discharge), presence of urinary tract infection, changes in the reproductive system such as: presence of polycystic fibroids and ovaries, number of previous pregnancies, number of abortions, menarche and first sexual intercourse.

A descriptive analysis of the variables was performed by comparing frequencies and using Pearson's Chi-square test with $P < 0.05$ and a 95% confidence interval, using a Microsoft Office Excel database and analyzed using the statistical package EPI-INFO (version 7.2). To obtain measures of association of the variables, the odds ratio calculation was then used. All variables with $P < 0.20$ in the univariate analysis were included in multivariate analysis using logistic regression, performed in SPSS version 21. In the final multivariate model, a significance index of $P < 0.05$ was considered and the final model which obtained the best fit was evaluated by the Hosmer-Lemeshow test.

This study took place after approval by the teaching and research nucleus of the Health Foundation of Vitória da Conquista and approval by the Human Research Ethics Committee of the Instituto Multidisciplinar em Saúde (Universidade Federal da Bahia), opinion 1.764 332.

RESULTS

After analyzing the placental tissue, the prevalence of colonization by *Mollicutes* with at least one of the three species: *M. hominis*, *U. urealyticum* and/or *U. parvum* among women who had a spontaneous abortion was 73.0%. In the larger study, in addition to

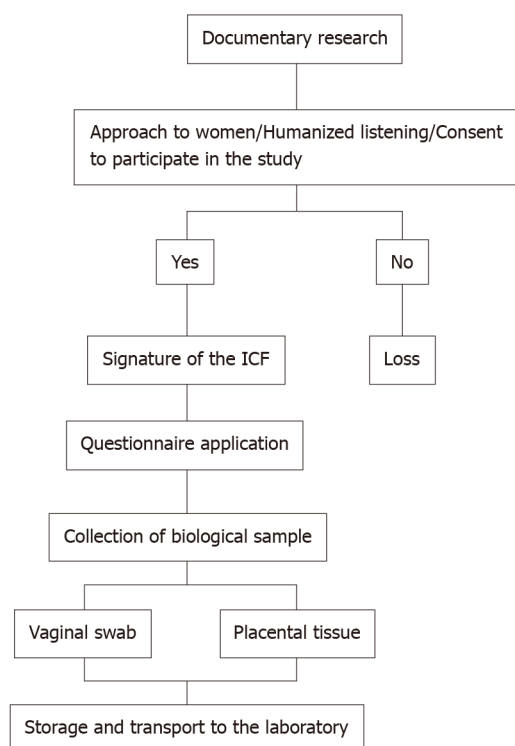


Figure 1 Flowchart of the data collection procedure. ICF: Informed consent form.

studying women who had abortions, the presence of *Mollicutes* in the placenta of women who completed their term pregnancy was also investigated. In this group, the presence of at least one species of those listed above was detected in 25% ($n = 5$) of women. When comparing colonization between the two groups of women, there was an 8.12-fold risk (CI: 2.66-24.78, $P < 0.001$), for placental colonization by at least one *Mollicutes* species in women who had an abortion, compared to those who completed their pregnancy.

Table 1 shows the descriptive analysis of women undergoing abortion who were included in the study ($n = 89$). The average age of the participants was 28 years. Most women reported having a partner, were from an urban area, were non-white and had more than 8 years of education. 65.2% ($n = 58$) of the study participants reported having a family income of up to one minimum wage, which at the time of the interview was R\$ 95400.

With regard to life habits, most of them reported not having changed their eating habits after the discovery of pregnancy, not smoking, not drinking alcohol and not taking part in physical activity. Regarding sexual and reproductive health, the majority declared that they did not have any gynecological disorders, such as fibroids, polycystic ovaries and never had a sexually transmitted infection. Of the interviewees, 65.1% ($n = 56$) started their sexual life aged more than 15 years, and reported having had more than one sexual partner in her life and not using condoms during sexual intercourse. Just over half of the participants reported having had up to 2 pregnancies in their lifetime.

The average gestational age at which the abortion occurred was 12 wk, ranging from 8 to 22 wk. 58.4% ($n = 52$) of the interviewees had at least one prenatal consultation and among all the women studied an average of 1.7 consultations occurred before the abortion. Most of the participants reported not having planned their pregnancy and having had some type of vaginal discharge in the last three months. A small number of women reported having had pelvic pain and dysuria.

Table 2 shows the results of the univariate analysis between the variables selected for the study and placental colonization by at least one of the studied *Mollicutes* species. It was found that women up to 29 years old had a 7.26-fold risk (CI: 2.49-21.12) of placental colonization by at least one of the studied *Mollicutes* species, compared with those older than 29 years. Women who reported menarche age of up to 13 years had a 3.15-fold risk (CI: 1.13-8.79) of placental colonization by at least one of the studied *Mollicutes* species compared with those who had menarche over 13 years. Women who had up to 2 pregnancies had a 2.73-fold risk (CI: 1.04 -7.05) of

Table 1 Descriptive analysis of women with spontaneous abortion participating in the study, Vitória da Conquista, Bahia, Brazil, 2018

| Variables | n | (%) |
|--------------------------------------------------------|----|------|
| Placenta colonized by <i>Mollicutes</i> | | |
| Yes | 65 | 73 |
| No | 24 | 27 |
| Age | | |
| Up to 29 yr | 52 | 58.5 |
| > 29 yr | 37 | 41.5 |
| Marital status | | |
| With companion | 68 | 78.2 |
| Without companion | 19 | 21.8 |
| Year of study ¹ | | |
| None | 2 | 2.3 |
| Up to 7 yr | 29 | 32.9 |
| > 7 yr | 57 | 64.8 |
| Origin | | |
| Rural area | 28 | 31.5 |
| Urban area | 61 | 68.5 |
| Skin color | | |
| White | 27 | 30.3 |
| Non-white | 62 | 69.7 |
| Income ^{1,2} | | |
| Up to the minimum wage | 58 | 65.2 |
| Above the minimum wage | 30 | 33.6 |
| Religion | | |
| Catholic | 49 | 55.1 |
| Others ⁵ | 26 | 29.2 |
| None | 14 | 15.7 |
| Changes in eating habits during pregnancy ³ | | |
| Yes | 10 | 11.5 |
| No | 77 | 88.5 |
| Physical activity ¹ | | |
| Yes | 16 | 18.2 |
| No | 72 | 81.8 |
| Alcohol consumption ⁶ | | |
| Yes | 14 | 15.7 |
| No | 75 | 84.3 |
| Smoking ⁶ | | |
| Yes | 4 | 4.5 |
| No | 85 | 95.5 |
| Gynecological disorders ^{1,7} | | |
| Yes | 9 | 88.7 |
| No | 79 | 10.3 |

| | | |
|---------------------------------------------------|----|------|
| Menarche | | |
| Up to 13 yr | 67 | 75.3 |
| > 13 yr | 22 | 24.7 |
| First sexual intercourse ⁴ | | |
| Up to 15 yr | 30 | 34.9 |
| > 15 yr | 56 | 65.1 |
| Number of partners ¹ | | |
| 1 | 53 | 60.2 |
| > 1 | 35 | 39.8 |
| Previous history of STI | | |
| Yes | 5 | 5.6 |
| No | 84 | 94.4 |
| Condom use during sexual intercourse ¹ | | |
| No | 51 | 57.9 |
| Sometimes | 37 | 42.1 |
| Pain during intercourse | | |
| Yes | 26 | 29.6 |
| No | 62 | 70.4 |
| Pregnancies (including the current one) | | |
| Up to 2 pregnancies | 53 | 59.5 |
| > 2 pregnancies | 36 | 40.5 |
| Premature births | | |
| None | 82 | 92.1 |
| More than one | 7 | 7.9 |
| Prenatal care | | |
| Yes | 52 | 58.4 |
| No | 37 | 41.6 |
| Pregnancy was planned ³ | | |
| Yes | 32 | 36.8 |
| No | 55 | 63.8 |
| Number of live children | | |
| 1 | 59 | 66.3 |
| > 1 | 30 | 33.7 |
| Presence of vaginal discharge | | |
| Yes | 58 | 65.2 |
| No | 31 | 34.8 |
| Dysuria | | |
| Yes | 16 | 18 |
| No | 73 | 82 |
| Groin swelling | | |
| Yes | 4 | 4.5 |
| No | 85 | 95.5 |
| Vaginal alteration ⁸ | | |

| | | |
|------------------|----|------|
| Yes | 9 | 10.1 |
| No | 80 | 89.9 |
| Vaginal itching | | |
| Yes | 27 | 30.3 |
| No | 62 | 69.7 |
| Vaginal erythema | | |
| Yes | 18 | 20.2 |
| No | 71 | 79.8 |
| Pelvic pain | | |
| Yes | 33 | 37.1 |
| No | 56 | 62.9 |
| Vaginal wart | | |
| Yes | 2 | 2.2 |
| No | 87 | 97.8 |
| Vaginal wound | | |
| Yes | 2 | 2.2 |
| No | 87 | 97.8 |

¹Non-responding.²Minimum salary of R\$ 954.00.³Non-responders.⁴Non-responders.⁵Evangelical, spirit, candomblé.⁶Any quantity and frequency.⁷Uterine fibroids, ovarian cysts.⁸Any anatomical or physiological change.

STI: Sexually transmitted infection.

spontaneous abortion and placental colonization by at least one of the studied *Mollicutes* species, when compared to those who had more than 2 pregnancies. For those with up to one live child, there was a 3.33-fold (CI: 1.25-8.84) risk compared to those who had more than one live child.

The final multivariate analysis (Table 3) revealed a statistically significant association between placental microbial colonization by *Mollicutes* in abortion and the variables: Age (women up to 29 years of age had a 7.55-fold risk of having a miscarriage, compared to those older than 29 years); menarche (women who had menarche up to 13 years of age had a 3.43-fold risk of having a miscarriage than those who had menarche over 13 years of age). A change in eating habits after the discovery of pregnancy appeared to be a protective factor.

DISCUSSION

Microbial colonization by *Mollicutes* in the urogenital tract may predispose to spontaneous abortion^[11,21]. In this study, the prevalence of microbial colonization by at least one of three *Mollicutes* species (*U. urealyticum*, *U. parvum*, *M. hominis*) in the placenta of women with spontaneous abortion was 73.0%. The prevalence of *U. urealyticum* in endocervical material from patients who had an abortion was 16.5% in another study^[22]. Previous studies were also carried out in other countries such as Germany, Switzerland and Australia, and showed evidence that the presence of *Mollicutes* and other microorganisms in the vaginal microbiota may be related to adverse pregnancy outcomes, including spontaneous abortion^[21,23,24].

In the present study, women who had up to one live child had a 3.33-fold risk (CI: 1.25-8.84) of abortion compared with those who had more than one live child. In addition, women who had 2 pregnancies had a 2.73-fold risk of abortion when colonized by *Mollicutes*, compared to those with more than 2 pregnancies. The

Table 2 Univariate analysis of placental colonization by *Mollicutes* in spontaneous abortion and selected variables, Vitória da Conquista, Bahia, Brazil, 2018

| Variable | OR (IC) | χ^2 | P value |
|--------------------------------------------------------|-------------------|----------|---------|
| Age | | | |
| Up to 29 yr | 7.26 (2.49-21.12) | 15 | 0.00 |
| > 29 yr | 1 | | |
| Marital status | | | |
| With companion | 1 | | |
| Without companion | 2.33 (0.62-9.08) | 1.69 | 0.19 |
| Year of study ¹ | | | |
| None | 1 | | |
| Up to 7 yr | 2.27 (0.12-39.64) | 0.3 | 0.57 |
| > 7 yr | 3.21 (0.18-54.79) | 0.72 | 0.39 |
| Origin | | | |
| Rural area | 1.15 (0.41-3.22) | 0.08 | 0.77 |
| Urban area | 1 | | |
| Skin color | | | |
| White | 1 | | |
| Non-white | 1.43 (0.49-4.13) | 0.44 | 0.5 |
| Income ^{1,2} | | | |
| Up to the minimum wage | 1.22 (0.46-3.26) | 0.17 | 0.67 |
| Above the minimum wage | 1 | | |
| Religion | | | |
| Catholic | 1 | | |
| Others ⁵ | 0.98 (0.33-2.86) | 0 | 0.97 |
| None | 0.90 (0.24-3.28) | 0.01 | 0.87 |
| Changes in eating habits during pregnancy ³ | | | |
| Yes | 1 | | |
| No | 3.05 (0.79-11.69) | 2.84 | 0.09 |
| Physical activity ¹ | | | |
| Yes | 1 | | |
| No | 1.26 (0.33-4.12) | 0.15 | 0.69 |
| Alcohol consumption ⁶ | | | |
| Yes | 5.75 (0.70-46.19) | 3.31 | 0.06 |
| No | 1 | | |
| Smoking ⁶ | | | |
| Yes | 1.11 | 0 | 0.92 |
| No | 1 | | |
| Gynecological disorders ^{1,7} | | | |
| Yes | 3.28 (0.38-27.78) | 1.32 | 0.25 |
| No | 1 | | |
| Menarche | | | |
| Up to 13 yr | 3.15 (1.13-8.79) | 5.07 | 0.02 |

| | | | |
|---------------------------------------------------|-------------------|------|------|
| > 13 yr | 1 | | |
| First sexual intercourse ⁴ | | | |
| Up to 15 yr | 2.17 (0.71-6.65) | 1.93 | 0.16 |
| > 15 yr | 1 | | |
| Number of partners ¹ | | | |
| 1 | 2.78 (0.16-46.33) | 0.55 | 0.45 |
| > 1 | 1 | | |
| Previous history of STI | | | |
| Yes | 1.5 (0.16-14.21) | 0.13 | 0.71 |
| No | 1 | | |
| Condom use during sexual intercourse ¹ | | | |
| No | 1 | | |
| Sometimes | 2.14 (0.78-5.87) | 2.24 | 0.13 |
| Pain during intercourse | | | |
| Yes | 1.36 (0.47-3.95) | 0.32 | 0.56 |
| No | 1 | | |
| Pregnancies (including the current one) | | | |
| Up to 2 pregnancies | 2.73 (1.04-7.15) | 4.36 | 0.03 |
| > 2 pregnancies | 1 | | |
| Premature births | | | |
| None | 1 | | |
| More than one | 2.17 (0.45-10.50) | 0.97 | 0.32 |
| Prenatal care | | | |
| Yes | 1 | | |
| No | 1.26 (0.48-3.09) | 0.22 | 0.63 |
| Pregnancy was planned ³ | | | |
| Yes | 1 | | |
| No | 1.33 (0.50-3.48) | 0.34 | 0.55 |
| Number of live children | | | |
| 1 | 3.33 (1.25-8.84) | 6.15 | 0.01 |
| > 1 | 1 | | |
| Presence of vaginal discharge | | | |
| Yes | 2.42 (0.92-6.33) | 3.33 | 0.06 |
| No | 1 | | |
| Dysuria | | | |
| Yes | 1.13 (0.32-3.92) | 0.03 | 0.84 |
| No | 1 | | |
| Groin swelling | | | |
| Yes | 1.11 (0.11-11.24) | 0 | 0.92 |
| No | 1 | | |
| Vaginal itching | | | |
| Yes | 1.27 (0.46-3.50) | 0.22 | 0.63 |
| No | 1 | | |

| | | | |
|------------------|------------------|------|------|
| Vaginal erythema | | | |
| Yes | 0.95 (0.29-3.02) | 0 | 0.93 |
| No | 1 | | |
| Pelvic pain | | | |
| Yes | 1.61 (0.58-4.44) | 0.88 | 0.34 |
| No | 1 | | |

¹Non-responding.²Minimum salary of R\$ 95450.³Non-responders.⁴Non-respondents.⁵Evangelical, spirit, candomblé.⁶Any quantity and frequency.⁷Uterine fibroids, ovarian cysts.

Table 3 Final regression model by groups of selected variables and the presence of *Mollicutes* in placental tissue of spontaneous abortion, Vitória da Conquista, Bahia, Brazil, 2018

| Variable | OR, IC (95%) | P value |
|--------------------------------|-------------------|---------|
| Age | | |
| Up to 29 yr | 7.55 (2.37-24.03) | 0.01 |
| > 29 yr | 1.0 | |
| Menarche | | |
| Up to 13 yr | 3.43 (1.03-11.44) | 0.04 |
| > 13 yr | 1.0 | |
| Dietary change after pregnancy | | |
| Yes | 0.16 (0.03-0.06) | 0.03 |
| No | 1.0 | |

Model adequacy test-Hosmer Lemeshow, $\chi^2 = 2.37$ $P = 0.49$. OR: Odds ratio.

literature demonstrates conflicting data on this issue, some studies have shown a protective effect against spontaneous abortion in women with more than one live child^[7], and some have indicated an increased risk in women with more than one live child^[8,21].

Results also vary with parity: the difficulty of becoming pregnant or the existence of complications in previous pregnancies may be the reason for past spontaneous losses^[6,7,20]. In other studies, women with more live children indicated a higher number of pregnancies, and had the greatest risk of abortion^[8,25].

Age up to 29 years was independently associated (OR = 7.55; CI: 2.37-24.03) with the presence of *Mollicutes* in the placenta of women with abortion. Age between 20 and 30 years was also associated with abortion and the presence of infectious diseases such as STORCH syndrome (syphilis, toxoplasmosis, rubella, cytomegalovirus and herpes virus)^[1] or the presence of *Ureaplasma spp* in the female genital tract^[26]. These findings are in line with other studies, where it was shown that young age (women under 29 years old) is a risk factor for the occurrence of spontaneous abortion, and younger pregnant women may have less access to health services. This implies fewer possibilities for early detection of infections associated with abortion^[1,6,22].

Findings from studies that evaluated prenatal programs and cervical screening using Pap smear, which has often shown a higher prevalence of the use of these services by older women, corroborates these findings^[27,28]. However, other studies diverge from these findings where the occurrence of spontaneous abortion occurs in a greater proportion of women over 35 years of age^[8,25], these studies are usually population-based and self-reported, and only point out that the older the age, the longer the time of exposure to pregnancy and abortion.

After final adjustment, women who had their first menstruation up to 13 years of age had a 3.43-fold risk (CI: 1.03-11.44) of developing spontaneous abortion with placental colonization by *Mollicutes* when compared to women who menstruated after 13 years. Early menarche was associated with spontaneous abortion^[6], and in Brazilian girls this age has decreased further, implying precocious reproduction, which may be related to a greater number of pregnancies among young women. This, together with other factors, can lead to an increase in the occurrence of spontaneous abortion^[29,30]. Thus, it can be inferred that sex education, and the provision of family planning by health services, should be started early, in order to avoid early pregnancies.

Prenatal care was also one of the variables examined in this study. Even though there was no statistical significance, it still deserves to be mentioned, as most of the participants stated that they had prenatal care before the abortion occurred. However the average number of consultations was 1.7 per woman, a very low rate, considering that the average gestational age at abortion was 12 wk. According to technical norms of the Ministry of Health, prenatal care must occur as early as possible. Right at the first consultation it is necessary to request laboratory tests and to perform a gynecological examination (specular and cytopathological examination). Also, at this time, the existence of urinary tract infections and the presence of bacterial vaginosis should be investigated. The latter is defined as infection of the female genital tract, where among several pathogens, *Mollicutes* can be the causative agents. This can provide an opportunity for the early diagnosis and treatment of these infections, preventing gestational adverse effects such as the occurrence of spontaneous abortion^[28,31,32].

Socioeconomic factors have been identified as important elements related to spontaneous abortion. Some studies have shown a significant association between low income levels, low education level and spontaneous abortion^[3,7,8]. In this study, income was not significantly associated with spontaneous abortion, but due to the homogeneity in this variable, most participants 65.2% ($n = 58$) reported income of up to one minimum wage, resulting in low power for comparison purposes.

Schooling has been reported in the literature to be an important factor related to the occurrence of spontaneous abortion. In countries such as Brazil, women who had up to 8 years of education had a 1.66-fold greater risk (CI: 1.11-2.49) of having a miscarriage, than those with more than 8 years of education^[6], and similar results have been found in other studies^[7,8]. These findings were not observed in this study, most women reported having more than 7 years of education; thus, education level was not significant. Among the women studied, the problem was access to health services than the lack of information.

In summary, it should be noted that this is a pioneering study in the southwestern region of Bahia, Brazil, which revealed a positive association between spontaneous abortion and placental colonization by *Mollicutes*. The study also showed an association between abortion and women up to 29 years of age, who had their first menstruation up to 13 years old. These findings require more detailed studies within this area, in order to provide a better epidemiological profile of women undergoing abortion and to support decision-making by health managers. Decision-making in abortion can have an important impact on reducing health costs, as managing the complications of abortion and its occurrence is much more costly than preventing it.

CONCLUSION

This is a pioneering study in the southwestern region of Bahia, which revealed a positive association between spontaneous abortion and placental colonization by *Mollicutes*, and abortion was also associated with women up to 29 years of age, who had their first menstruation up to 13 years of age. These findings are important, but point to the need for more detailed studies within this area, in order to provide a better epidemiological profile of women undergoing abortion to support decision-making by health managers, with a view to decreasing health costs, since the prevention of abortion is much less costly than managing its occurrence and complications.

ARTICLE HIGHLIGHTS

Research background

Abortion is of great importance in public health, as it is among the main causes of

maternal morbidity and mortality. In addition to sociodemographic- and lifestyle-related factors, studies have demonstrated that infections of the genital tract are associated with higher rates of abortion. The increased presence *Mollicutes* in the genitourinary tract may be related to higher rates of abortion. In addition, the diagnosis of this infection requires complex culture media, making the diagnosis more difficult, thus knowledge of the local epidemiological rates of these infections can guide clinical practice.

Research motivation

The importance of understanding the factors that may be related to spontaneous abortions is inadequate in clinical practice in order to avoid such outcomes and to ensure better public health principles.

Research objectives

To perform an epidemiological analysis of women with spontaneous abortion and placental colonization by *Mollicutes* in a maternity hospital.

Research methods

This is a cross-sectional study which involved the collection of data and biological material from women hospitalized due to spontaneous abortion or for term delivery. The sample analyzed consisted of 89 women who miscarried and 20 women who had full term pregnancy. Data collection took place in three stages: (1) Conducting research to identify information and clinical data in the medical records of patients hospitalized due to abortion; (2) Application of a semi-structured questionnaire to identify the patient's epidemiological profile; and (3) Collection of placental tissue. Placental samples were collected after the curettage procedure (abortion) and after placental expulsion (delivery), both performed by an obstetrician. Microbial identification of the fragments was performed by real-time polymerase chain reaction. In this study, the following explanatory variables were considered: (1) Sociodemographic variables; (2) Variables related to access to health services; (3) Variables related to lifestyle; and (4) Variables related to sexual and reproductive health, all of which were used to perform descriptive, univariate and multivariate analyses.

Research results

Colonization by *Mollicutes* was observed in 73.0% of the study participants. In the final model, placental colonization by *Mollicutes* was independently associated with the variables age [odds ratio (OR) = 7.55; CI: 2.37-24.03] and menarche (OR = 3.43; CI: 1.03-11.44). In this investigation, 73.0% of women who had a spontaneous abortion had colonization by *Mollicutes*. When comparing colonization between the two groups of participating women, there was an 8.12-fold risk of placental colonization by at least one *Mollicutes* species in those who had an abortion, compared to those who completed pregnancy. The final multivariate analysis model revealed a statistically significant association between placental microbial colonization by *Mollicutes* and abortion in relation to the variables: age, where women up to 29 years old had a 7.55-fold risk of spontaneous abortion, compared to those older than 29 years; menarche, where women who had menarche up to 13 years old had a 3.43-fold risk of miscarriage compared to those who had menarche over 13 years old; and change in eating habits, after the discovery of pregnancy, was a protective factor (OR = 0.16).

Research conclusions

Our study revealed a positive association between spontaneous abortion and placental colonization by *Mollicutes*. This signals the need for more investigations on this issue, in order to guide decision-making for the prevention of abortion.

Research perspectives

The information provided by this study is applicable for the development of guidelines for the prevention of abortion.

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- 16 Teenage pregnancy and the sociodemographic attributes as a major contributor: Findings from an urban referral center in Nepal

Thapa P, Thapa P, Shrestha DB, Budhathoki P, Karki B, Mahat B

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Clinical and Translational Research

Teenage pregnancy and the sociodemographic attributes as a major contributor: Findings from an urban referral center in Nepal

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Informed consent was taken from all respondents meeting inclusion criteria before they were enrolled in the study.

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Abstract

BACKGROUND

Teenage pregnancy is a challenging issue worldwide. Yet, despite the increased health risk and socioeconomic impact of teenage pregnancy, the numbers remain high in Nepal.

AIM

To determine the prevalence and sociodemographic factors associated with teenage pregnancy in Nepal.

METHODS

A hospital-based cross-sectional study was conducted in the Paropakar Maternity and Women's Hospital from April to August 2017. A total of 1359 mothers were assessed and interviewed regarding their reproductive history and sociodemographic attributes. Ethical approval from the Nepal Health Research Council, permission from the concerned hospital, and consent from study subjects were obtained.

authors have nothing to disclose.

Data sharing statement: All available data is analyzed and presented in the study as appropriate.

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RESULTS

Of the 5526 deliveries, 679 (12.3%) were teenage pregnancy deliveries. The majority (85.1%) of mothers (out of 1359) were married at < 20 years of age, with a mean age of marriage of 17.57 years (± 1.994 , range: 12-25 years). Marriage age was a significant determinant of teenage pregnancy (odds ratio [OR] 2.423 [2.262-2.596]; $P < 0.001$). Likewise, a love marriage (OR: 2.018 [1.585-2.570]; $P < 0.001$) and first teenage pregnancy (OR: 3.622 [3.265-4.017]; $P < 0.001$) were significant determinants for subsequent teen pregnancies. Knowledge of family planning methods (OR: 0.474; 0.288-0.779; $P = 0.003$) and use of any methods of family planning utilization (OR: 0.345; 0.248-0.479; $P = 0.000$) significantly lowered the chance of teenage pregnancy.

CONCLUSION

Teenage pregnancy occupies a substantial proportion of total deliveries in the Nepalese maternity hospital. In addition, early pregnancy was significantly associated with age and type of marriage, education level, knowledge, and practice of contraceptive methods.

Key Words: Contraception; Nepal; Reproductive health; Teenage pregnancy; Marriage; Education

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Core Tip: This study evaluated the prevalence and sociodemographic factors associated with teenage pregnancy in Nepal. Teenage pregnancy carries a significant proportion of total deliveries in a Nepalese maternity hospital. Early pregnancy was significantly associated with age at marriage, education level, type of marriage, and contraceptive practice.

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INTRODUCTION

The United Nations Children's Fund defines teenage pregnancy as pregnancy in a girl aged 13-19 years[1]. This usually refers to pregnant girls who have not reached legal adulthood, which varies worldwide. Approximately 21 million girls aged 15 to 19 years and 2 million girls under 15-years-old become pregnant in developing regions every year[2]. About 16 million girls aged 15-19 years and 2.5 million girls under age 16 give birth in developing regions[3]. In South Asia, the early marriage of adolescents is common, and 25%-35% of adolescent girls in Pakistan, Bangladesh, India, and Nepal begin childbearing as early as 17 years[4]. About 90% of births to adolescents occur within marriage in developing countries, mainly due to customs and traditions and lack of education and information about reproductive and sexual health[5,6]. Various socioeconomic problems such as school dropout and unemployment and psychological issues such as depression are also common among teenage pregnancy[7, 8]. In addition, multiple factors including rural residence, not attending school, low educational status of parents and lack of communication between teenagers and parents on sexual and reproductive health issues, and lack of knowledge about contraceptive methods are associated with teenage pregnancy[9].

Teenage pregnancy is a challenging issue for families and adolescent parents. It is associated with higher rates of morbidity and mortality for both the mother and infant. Teenage pregnancy is associated with an increased risk of neonatal complications like prematurity, low birth weight, intrauterine growth restriction, neonatal mortality, and stillbirth[5,6,10]. Maternal complications such as pregnancy-induced hypertension, preeclampsia, malnutrition and anemia in pregnancy, perineal tear, episiotomy, and

cesarean delivery are also common among teenagers[11,12]. Risks for medical complications are more significant for girls ≤ 14 years of age, as an underdeveloped pelvis can lead to difficulties in childbirth[13]. In Nepal, where marriage is universal and occurs at young ages, early teenage pregnancy is of prime public health importance. This study was conducted to determine the burden of teenage pregnancy in an urban referral maternity hospital of Nepal and to analyze sociodemographic factors as determinants.

MATERIALS AND METHODS

Study setting and population

A hospital-based cross-sectional study was carried out from April to August 2017 to determine the proportion of teenage deliveries and factors associated with early pregnancy. Study samples were selected from the Paropakar Maternity and Women's Hospital, a tertiary level referral maternity hospital in Nepal and the only semi-government hospital providing maternity services to the general public. Mothers who attended the study hospital for the delivery during the study period were interviewed, and data on sociodemographic characteristics, reproductive history, and social behaviors were collected.

Cases consisted of all teenage women who came to the hospital for delivery. They were interviewed during the prenatal period and 1 or 2 d postpartum depending on the mother's level of comfort and readiness. In addition, women who came to the same hospital for delivery and were aged ≥ 20 years were selected randomly in equal numbers within 24 h for comparison purposes, and constituted the controls.

Data collection

A pretested semi-structured questionnaire in the Nepali language was used to interview 1359 patients. Female interviewers with health backgrounds were recruited and trained on sampling, interview techniques, and subjects' rights and comfort. Information on sociodemographic characteristics, reproductive history, and knowledge and practice on contraceptive methods was obtained. The data collection sheet is attached as supplementary file.

Major variables

Sociodemographic variables: Marital status (marriage age, type), ethnicity (Brahmin and Chhetri or others), religion (Hindu or others), family type (nuclear, joint or extended), age of first pregnancy, educational status (of the patient and her husband), occupation (of patient and husband), family planning (knowledge and practice of patient), parent's education and work.

Type of family: Nuclear meant parents and children only, joint meant grandparents, parents, and children while extended meant including families of brothers and grandparents and children.

Teenage pregnancy: A pregnant woman under 20 years of age was the dependent variable for this study.

Religion: Hindu was the most common religion. Other religions included Christian, Muslims, and Buddhists.

Educational status: We recorded the academic level of the patient, her mother, and her husband. Education was categorized into two categories: "educated" referred to people who studied to Grade 8 or above and "uneducated" referred to illiterate people or those who studied to less than Grade 8.

Occupation: Classified into two categories: "employed" referred to people working for governmental or non-governmental organizations or doing their own business or labor and "un-employed" referred to people with no formal job/work but doing something to sustain life.

Family planning knowledge: Classified into two categories: those who knew about the basics of family planning, including family planning methods, were classified as "Yes" and those with no information or insight about family planning were classified as "No."

Family planning practice: Classified into two categories: those who used any family planning device were recorded as "Yes" and those who had never used any method of family planning were recorded as "No."

Statistical analyses

Data were entered in EPIDATA version 2.0 and imported and analyzed using SPSS version 22 (Statistical Package for Social Sciences, Chicago, IL, United States). Univariate analyses were conducted for all studied variables and presented as the frequency and percentage in the appropriate tables to evaluate the distribution of each sociodemographic variable. Later cross-tabulation analyses were done between teen and non-teenage pregnancy using the χ^2 test and risk ratios. Finally, logistic regression analyses were run to estimate the odds ratios of relevant predicting variables to explore how predictor X (exposure variables) is related to Y (outcome variable) with a dichotomous response. We defined the response as Y = 0 or 1, where Y = 1 denotes our event of interest occurrence; here, it was non-teenage pregnancy = 0 and teen pregnancy = 1. The exposure variables were edited and made categorical for study convenience as appropriate. ArcGIS was used to evaluate the spatial distribution of patients enrolled in the study across Nepal based on their permanent residency address.

Teenage mothers were further divided into two groups for the analyses: age ≤ 17 years and age > 17 years.

Research ethics

Informed consent was provided from all respondents meeting the inclusion criteria before enrollment in the study. The study protocol was approved by the Ethical Review Board of Nepalese Health Research Council and conducted according to the protocol.

RESULTS

A total of 5526 deliveries occurred in Paropakar maternity hospital in the study period from April 14, 2017 to August 14, 2017. Of the 1359 women, 679 teenage mothers (12.28%) matched to 680 non-teen mothers, were enrolled. The menarche age of the included cohort was 13.55 ± 1.342 (range: 9-18) years. The majority of participants were married under age 20 with a mean age of marriage of 17.57 ± 1.994 (range: 12-25) years. Most married females were living with their husbands, and more than two-thirds were in love marriages. Most reported their first pregnancy as teenagers at a mean age of 18.50 ± 2.145 (range: 13-25) years. Nearly one-third of participants were from Brahmin and Chhetri ethnicity (upper caste), with the majority following Hinduism. In total, 58.9% of participants were living in a nuclear family, and 71.5% had above Grade 8 education. However, only 16.6% reported formal employment, and 79.8% said their pregnancy was planned (Table 1).

Based on the permanent address of residency among the participants in the study, spatial distribution showed that the majority of participants were from province three. Still, overall, the different districts of Nepal were represented. Therefore, 1337 individuals with permanent residency in Nepal were plotted after excluding 22 Indian national Figure 1. Details of address and sociodemographic determinants are included in the supplementary files (Supplementary Table 1, Supplementary material and Table 1).

Table 2 depicts each sociodemographic determinant of pregnancy and its association with teenage and non-teenage pregnancy. Determinants of teenage pregnancy were: age at marriage ($P \leq 0.001$), love marriage ($P \leq 0.001$), and being a teenager at first pregnancy ($P \leq 0.001$). In addition, belonging to the upper caste ($P = 0.001$), higher education of the patient ($P \leq 0.001$) and husband ($P = 0.002$), knowledge of family planning ($P \leq 0.001$), and use of family planning ($P \leq 0.001$) were negatively associated with teenage pregnancy (Table 2).

Arranged marriage has a 45% lower chance of teenage pregnancy compared to love marriage. Participants' education status of higher than Grade 8 showed a 33% lower chance of teen pregnancy as an outcome compared to education lower than Grade 8. Knowledge of family planning methods and use of any forms of family planning are associated with significantly lower teenage pregnancy rates (Table 3).

Table 1 Socio-demographic profile of the participants, *n* = 1359

| Variables | | | <i>n</i> (%) |
|------------------------------------|----------------------|---------------------------------|--------------|
| Type of pregnancy | | Teen | 679 (50.0) |
| | | Non teenage | 680 (50.0) |
| Age of marriage in yr | | Teenage | 1156 (85.1) |
| | | Non-teenage | 203 (14.9) |
| Living arrangement | | Married and living with husband | 1261 (92.8) |
| Marriage type | | Love marriage | 972 (71.5) |
| | | Teen | 938 (69.0) |
| Temporary address | | In the Kathmandu valley | 1116 (82.1) |
| | | Outside the valley | 243 (17.9) |
| Permanent address | | In the Kathmandu valley | 169 (12.4) |
| | | Outside the Valley | 1190 (87.6) |
| Ethnicity | | Upper Caste | 398 (29.3) |
| | | Others | 961 (70.7) |
| Religion | | Hindu | 1046 (77.0) |
| Family type | | Nuclear | 800 (58.9) |
| Education | Grade ≥ 8 | Patient | 972 (71.5) |
| | | Husband | 961 (70.7) |
| | | Mother | 71 (5.2) |
| | Illiterate/< Grade 8 | Patient | 387 (28.5) |
| | | Husband | 397 (29.2) |
| | | Mother | 1288 (94.8) |
| Employment | Formally employed | Patient | 225 (16.6) |
| | | Husband | 644 (47.4) |
| | Unemployed | Patient | 1134 (83.4) |
| | | Husband | 714 (52.5) |
| Knowledge of family planning | | Yes | 1141 (84.0) |
| Use of any family planning methods | | No | 887 (65.3) |
| Present pregnancy | | Planned | 1085 (79.8) |

DISCUSSION

Our cross-sectional study evaluated different sociodemographic factors responsible for teenage pregnancy in Nepal. The prevalence of adolescent pregnancy in Africa is 18.8%[9]. The teenage pregnancy prevalence was found to be 12.28% in the tertiary center of Nepal in our study, which is lower than the national rate of 19.8% of Nepal but is higher than the rate of 4.5% in South-Eastern Asia[14]. We found that early age at marriage is a significant factor associated with teenage pregnancy. In Nepal, early marriage occurs due to societal norms in which families marry their daughter at an early age, believing it will cut the expense[15]. Those married at an early age have decreased knowledge about reproductive health and contraception, leading to unwanted pregnancy. Similar findings of teenage pregnancy association with earlier marriage age have also been found in Africa[14]. A retrospective study showed the increased role of parents in early marriage without the daughter's consent[16]; however, most marriages in our research were love marriages. This might be explained because most of the study population lived in Kathmandu, although they were from outside the valley. Due to migration to Kathmandu, many teenage females gain independence and might have indulged in sexual relationships leading to marriage. Another significant finding of our study was that girls with higher

Table 2 Cross-tabulation between teenage and non-teenage pregnancy and their distribution and association with sociodemographic variables

| Variables | | Present pregnancy type | | Unadjusted OR (95%CI) |
|------------------------------------|---------------------------------|------------------------|-------------|----------------------------------|
| | | Non teenage, n (%) | Teen, n (%) | |
| Age marriage | Below 20 | 477 (41.3) | 679 (58.7) | 2.423 (2.262-2.596) ¹ |
| Living arrangement | Married and living with husband | 631 (50.0) | 630 (50.0) | 0.998 (0.662-1.506) |
| Marriage type | Love marriage | 439 (45.2) | 533 (54.8) | 2.018 (1.585-2.570) ¹ |
| Age 1 st pregnancy | Teen | 259 (27.6) | 679 (72.4) | 3.622 (3.265-4.017) ¹ |
| Temporary address | In the valley | 569 (51.0) | 547 (49.0) | 1.237 (0.936-1.634) |
| Permanent address | In the valley | 93 (55.0) | 76 (45.0) | 1.257 (0.909-1.737) |
| Ethnicity | Upper Caste | 227 (57.0) | 171 (43.0) | 1.489 (1.176-1.884) ¹ |
| Religion | Hindu | 536 (51.2) | 510 (48.8) | 0.811 (0.629-1.044) |
| Family Type | Nuclear | 404 (50.5) | 396 (49.5) | 0.956 (0.770-1.187) |
| Education-patient | Grade 8 or above | 519 (53.4) | 453 (46.6) | 1.608 (1.267-2.041) ¹ |
| Education-husband | Grade 8 or above | 507 (52.8) | 454 (47.2) | 1.446 (1.143-1.830) ¹ |
| Education-mother | Grade 8 or above | 34 (47.9) | 37 (52.1) | 1.095(0.679-1.767) |
| Employment-patient | Unemployed | 562 (49.6) | 572 (50.4) | 1.122 (0.843-1.495) |
| Employment-husband | Unemployed | 357 (50.0) | 357 (50.0) | 1.006 (0.813-1.245) |
| Knowledge of family planning | Yes | 626 (54.9) | 515 (45.1) | 3.692 (2.657-5.129) ¹ |
| Use of any family planning methods | Yes | 307 (65.0) | 165 (35.0) | 2.564 (2.034-3.232) ¹ |
| Present pregnancy | Planned | 548 (50.5) | 537 (49.5) | 0.911 (0.699-1.188) |

¹Statistically significant.

education more than Grade 8 have significantly decreased chances of pregnancy compared to illiterate or low education girls. This is in agreement with the Nepalese Demographic and Health Survey (NDHS), which showed that girls with an education of Grade 10 or more get pregnant 4 years later than uneducated ones, and about 44.1% of teenage pregnancies occur in uneducated or girls with education level of primary [3]. The pooled analyses of the data from three national NDHS surveys showed that teenage pregnancy is associated with a low level of education, similar to our study[7].

Similarly, a cross-sectional study done in another tertiary center of Nepal showed that teenage pregnancies were seen in females who dropped out of school for various reasons[8]. Also, the studies done by Sharma *et al*[15] and Shrestha[16] showed an increased association of teenage pregnancies with lower education levels[15,16]. There is a similar scenario of low education being associated with teenage pregnancy in Africa and South Asia because the lack of education prevents the empowerment of teenagers with the necessary skills and knowledge to prevent pregnancy[14,17].

The lack of knowledge of family planning and use of family planning methods were significantly associated with teenage pregnancies in our study. Social stigma prohibits discussion and education about reproductive health in Nepal, leading to unsafe sex. The retrospective study done by Shrestha[16] found that a minimal number of teenage girls used any form of contraception[16]. Although various studies have suggested that teenage girls know about contraception all over South Asia, the lack of proper contraception in teenagers is the main problem. Our study found that teenage girls lack this knowledge, which contributes to teenage pregnancy[17]. Similar findings of lack of sexual knowledge have been reported in Africa, as well as a lack of access to contraceptives and unfavorable attitude of the community towards contraception[14]. Our study found no association of teenage pregnancy with employment status, in contrast with the pooled analysis done by Poudel *et al*[7], who showed lower teenage pregnancy rates among skilled professional women[7].

Similarly, we did not find an effect of upper caste on teenage pregnancy while doing multivariate logistic regression, unlike a prior study that showed a lower rate of teenage pregnancy in upper-caste like Brahmin and Chettri[10]. Our study found no

Table 3 Binary logistic regression analysis of predictors of teen pregnancy

| Variables | | Adjusted OR | 95%CI for OR | | P value |
|----------------------------------------|----------------------------------------------|-------------|--------------|-------|--------------------|
| | | | Lower | Upper | |
| Marriage age | At or above 20 | 1.040 | 0.000 | . | 1.000 |
| | Below 20 ¹ | | | | |
| Marital state and living with | Husband abroad, separated or others | 0.902 | 0.477 | 1.708 | 0.752 |
| | Married and living with husband ¹ | | | | |
| Marriage type | Arrange marriage | 0.550 | 0.389 | 0.778 | 0.001 ^b |
| | Love marriage ¹ | | | | |
| 1 st pregnancy based on age | Non Teen | 0.000 | 0.000 | . | 0.993 |
| | Teen ¹ | | | | |
| Temporary address | In the Kathmandu valley | 1.093 | 0.699 | 1.710 | 0.696 |
| | Outside the valley ¹ | | | | |
| Permanent address | In the Kathmandu valley | 1.215 | 0.712 | 2.072 | 0.475 |
| | Outside the valley ¹ | | | | |
| Ethnicity | Upper caste | 0.884 | 0.619 | 1.260 | 0.495 |
| | Others ¹ | | | | |
| Religion | Others | 0.938 | 0.646 | 1.361 | 0.735 |
| | Hindu ¹ | | | | |
| Family type | Joint or extended | 1.192 | 0.826 | 1.722 | 0.348 |
| | Nuclear ¹ | | | | |
| Education status | Grade 8 or above | 0.670 | 0.522 | 0.861 | 0.002 ^b |
| | Illiterate or less than Grade 8 ¹ | | | | |
| Husband Education status | Grade 8 or above | 0.783 | 0.611 | 1.003 | 0.053 |
| | Illiterate or less than Grade 8 ¹ | | | | |
| Education status of Mother | Grade 8 or above | 1.095 | 0.679 | 1.767 | 0.710 |
| | Illiterate or less than Grade 8 ¹ | | | | |
| Employment status | Formally employed | 0.988 | 0.646 | 1.511 | 0.956 |
| | Unemployed ¹ | | | | |
| Husband Employment status | Formally employed | 0.807 | 0.590 | 1.104 | 0.180 |
| | Unemployed ¹ | | | | |
| Knowledge of family planning | Yes | 0.474 | 0.288 | 0.779 | 0.003 ^b |
| | No ¹ | | | | |
| Use of any family planning methods | Yes | 0.345 | 0.248 | 0.479 | 0.000 ^c |
| | No ¹ | | | | |
| Present pregnancy | Unplanned | 0.911 | 0.635 | 1.307 | 0.612 |
| | Planned ¹ | | | | |

¹Reference taken, 95% confidence interval and 5% standard error considered, with < 0.05 as significance.

^aP < 0.05.

^bP < 0.01.

^cP < 0.001.

association between religion and teenage pregnancy. However, a study done by Shrestha[16] found that Hindu teenagers are more likely to be pregnant than Buddhist teenagers[16]. There was no association between type of family and teenage pregnancy

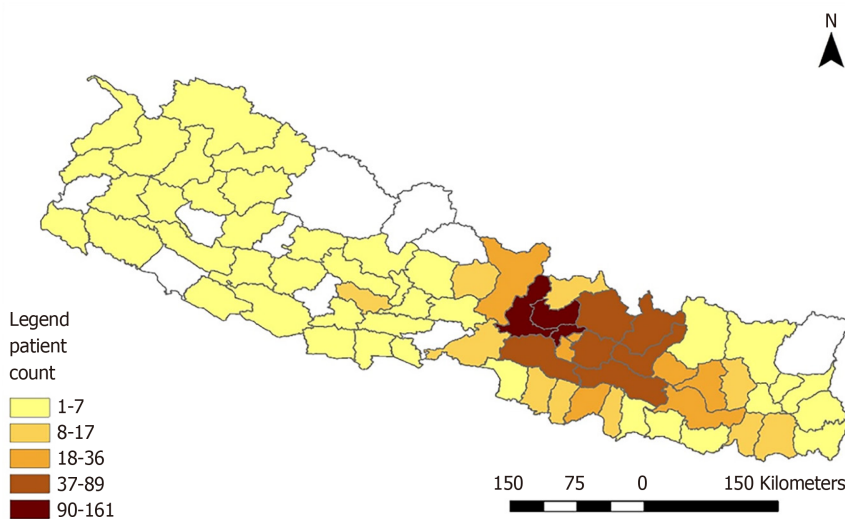


Figure 1 Spatial distribution of patients included in the study based on their permanent residency within Nepal.

in our study.

Limitations

Although our study had an adequate sample size and good statistics, there were several limitations. First, our study was done in a tertiary center in the developed city of Kathmandu; hence it cannot be generalized to the entire population. Second, we did not evaluate the role of economic status in teenage pregnancy, a factor that is a strong determinant in teenage pregnancies[7,17].

CONCLUSION

Teenage pregnancy constituted a significant proportion of deliveries at the urban referral center of Nepal. There was a significant association between teenage pregnancies and early age at marriage. Love marriages, low level of education, lack of knowledge of family planning and contraception were substantial determinants of teenage pregnancy.

ARTICLE HIGHLIGHTS

Research background

Teenage pregnancy is a global problem with increased prevalence in developing nations. It is associated with various maternal and neonatal complications. Multiple factors including rural residence, low level of education, and lack of contraceptive knowledge are believed to play a role in teenage pregnancy.

Research motivation

Studies regarding the prevalence of teenage pregnancy and various associated factors associated are rare in Nepal. Therefore, our goal was to study the status of teenage pregnancy among patients visiting a tertiary center in the capital city of Nepal.

Research objectives

The study's objective was to determine the proportion of teenage pregnancy and the effects of various sociodemographic factors on pregnant women visiting the tertiary center of Nepal.

Research methods

We conducted a hospital-based cross-sectional study in a tertiary center from April to August 2017. Pregnant women were interviewed regarding their reproductive history and sociodemographic variables. Before the interview, informed consent was

provided, and ethical approval was given from Nepal Health Research Council.

Research results

The prevalence of teenage pregnancy was 12.3%. More than four-fifths of the mothers were married under 20-years-old. Love marriage and first teenage pregnancy increased the odds for subsequent teenage pregnancies. On the other hand, knowledge of family planning methods and first teenage pregnancy lowered the odds of teenage pregnancy.

Research conclusions

Teenage pregnancy was highly present at the tertiary center of Nepal. Teenage pregnancy was associated with marriage at an early age. Increased odds of teenage pregnancy were seen among mothers with low education, lack of knowledge of family planning, and use of contraception.

Research perspectives

Developing nations like Nepal should focus on raising awareness of contraception and improving people's education and awareness to better tackle the adverse maternal and neonatal effects caused by teenage pregnancy.

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