

# ‘Does HPV affect my fertility?’ Reproductive Concerns of HPV-positive women: a qualitative study

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## Abstract

**Objective** To explore the reproductive concerns of women infected with human papillomavirus HPV **Design** Qualitative study with conventional content analysis approach **Setting** A large busy colposcopy clinic in Valiasr hospital (Tehran) **Sample** Twenty Iranian women tested positive for high-risk HPV types or both high-risk and low-risk HPV strains **Methods** In-depth face-to-face semi-structured interviews were conducted transcribed verbatim and analysed using conventional content analysis approach with the aid of MAXQDA.10 software **Main Outcome Measures** HPV-positive women’s reproductive concerns **Results** Exploring participants’ concerns about fertility and childbearing, three main categories extracted from the interviews, namely: concerns about fertility potential, pregnancy concerns, and non-pregnancy reproductive concerns. Women were concerned about the impact of HPV on male/female fertility potential, fetal health, pregnancy outcomes (miscarriage and preterm delivery), and breastfeeding. Women with cervical abnormalities were anxious that becoming pregnant or taking hormonal contraception might worsen their condition. Most participants were reluctant to use a condom. Married women wanted to know why they were advised to use a condom when they already had HPV. Women also asked about the potential reproductive risks of the HPV vaccine. **Conclusions** HPV-positive women had some reproductive concerns that should be considered in the designing of educational-consulting interventions. Women need to be better understood and informed about the impact of HPV on their reproductive health. Health care providers may lack knowledge about these specific areas, and they could benefit from additional up-to-date information to address women’s reproductive concerns.

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HPV-positive women had some reproductive concerns that should be considered in the designing of educational-consulting interventions. Women need to be better understood and informed about the impact of HPV on their reproductive health. Health care providers may lack knowledge about these specific areas, and they could benefit from additional up-to-date information to address women's reproductive concerns.

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## Tweetable abstract

HPV-positive women concerned about fertility potential, fetal health, pregnancy outcomes and breastfeeding.

## Keywords

Reproductive Health, Qualitative Research, Fertility, Female, Warts, Human Papillomavirus, Iran, Papillomavirus Infection, Pregnancy Outcome, Sexually Transmitted Diseases

## Introduction

HPV is the most prevalent sexually transmitted infection among men and women of reproductive age worldwide (1), and its effect on cancer induction is well known (2). HPV infections are significantly associated with many alterations of reproductive function (1).

In comparison to studies related to HPV oncogenic effect, there is a lack of studies focused on the impacts that HPV may have on fertility and reproductive systems. This aspect of HPV infection deserves more attention because if HPV is not the leading cause of reduced fertility or infertility, it must be considered as a risk factor of it (3). It appears from the studies that HPV can be associated with adverse pregnancy outcomes such as miscarriages and premature delivery (3).

Existing evidence suggests that HPV testing reaches the maximum level of accuracy in cervical screening (4). In Iran, HPV screening recommendations established for all women aged 30–59 (5), which led to detecting many new cases of HPV in women of childbearing age (6).

Some studies have addressed the fertility and pregnancy concerns of HPV-positive women. In a study conducted in the United States reported that many women expressed fear associated with role of HPV in their future pregnancy (7). In other studies, women expressed worries surrounding HPV and female subfertility (8-13). One study addressed women's concern about the HPV-associated risks of preterm delivery and implications of natural delivery from an HPV-infected birth canal (12). In another study women were worried about the HPV transmission to the fetus (14).

To date, several qualitative studies have been explored adverse psychological responses to HPV diagnosis and the most of the reproductive concerns emerged from these studies received far less attention. It is worth noting that some HPV-positive women suffer from genital warts (GWs) that must not be overlooked. Women with GWs often excluded from the previous studies while these women may have additional concerns. Given the effect HPV may have on women of reproductive age, the provision of support and interventions for infected women requires a deep understanding of their concerns. There have been no qualitative studies to investigate reproductive concerns and informational needs of HPV-positive women particularly in the Islamic cultural background. Therefore, we conducted interviews with Iranian HPV-infected women to better understand their reproductive concerns.

## Methods:

The present qualitative study was conducted based on the conventional content analysis approach to understand the reproductive concerns of HPV-positive women by exploring their feelings, experiences, and perceptions (15).

This study was carried out from September 2018 to December 2019 at the referral gynecology-oncology outpatient clinic of Valiasr (located in Imam Khomeini hospital complex, a large, busy, university-based, and geographically accessible complex in Tehran) serving a large population of women from across the country. The clinic is equipped with colposcopy and directed by oncologist-gynecologist SHSH and her colleagues.

A coordinator of Valiasr clinic sent all women tested positive for HPV (either only high-risk HPV or both high-risk/low-risk strains) to the interviewer (KQ-female- no relationship with participants) in the calm, convenient room to provide them information about the purpose and methods of the study. Women were eligible for interview if they were over 18 with a heterosexual partnership; had no severe disease (including cervical cancer) and were willing to share their experiences. A maximum variation purposive sampling was used to recruit information-rich candidates with diverse age, marital status, education, and socioeconomic status. In total, 20 Persian-speaking women with different ethnic, cultural, and religious backgrounds were included. Two invited women refused to participate because they prefer not to discuss HPV. Since the clinic is crowded, all participants interviewed during their waiting hours. Semi-structured one-to-one interviews were conducted using an interview guide (Appendix 1) started with the demographic background and reproductive and screening history. Three pilot-interviews were done (included in the study) to improve questions. Memos aided to design the next questions of the subsequent interviews. Besides, field notes were written during the interviews. Face-to-face in-depth interviews with participants' consent were recorded (lasted between 35 and 90 minutes), transcribed verbatim, and collected until data saturation was reached over fifteen months.

The data analysis was performed concurrently with data collection, using a qualitative content analysis approach described by Burnard et al. (16) using MAXQDA 10 software. Initially, interview transcripts, memos, and field notes were integrated, and two coders (KQ and STM) read the transcriptions multiple times to formulate a general understanding of the whole data. Open coding was based on this approach. Primary codes were then reduced by constant comparison and combination. The extracted codes were then brought together in terms of similarities and differences. The sub-categories with similar content were interpreted in a higher level of abstraction into the main categories.

The accuracy of this qualitative research was ensured according to the four criteria proposed by Guba and Lincoln, namely credibility, dependability, confirmability, and transferability (17, 18). The credibility criterion was achieved through prolonged engagement and member checking, by which, the transcript and extracted codes from the interview were returned to each interviewee to approve their accuracy. Confirmability and dependability of the results were ensured by peer debriefing and external checking. Therefore, two observers reviewed and rechecked all transcripts, codes, and themes. Finally, this process completed with numerous discussions among the research team about areas of disagreement until reaching a final consensus. To enhance the transferability of the results, we tried to consider the maximum variation during sampling. We interviewed women with diversity in age, relationship status, education, socioeconomic status, and cultural background. In qualitative research, generalizability labeled as a full description of the setting, the participants, and the themes in rich detail through the lens of the outside reader. To attain dependability, the process within the study was described in detail.

This study was undertaken as a part of a Ph.D. thesis in Reproductive Health, which was reviewed and approved by the Ethics Committee of Tehran University of Medical Sciences (IR.TUMS.FNM.REC.1397.139). Moreover, Valiasr hospital managers willingly facilitated the study. Written informed consent was obtained from all the participants. Direct quotes that are representative of the participants have been presented.

## Results:

The characteristics of participants as shown in Table 1 demonstrate the heterogeneity of the sample. Participants averaged 33.9 years (aged 23–47). Details in parentheses following quotes represent the participant's identification number. Half of 20 women interviewed had children and 70 percent (14) were married.

Many women reported seeking information about fertility and pregnancy from a range of sources, including the Internet, their healthcare provider, and other women with HPV. They indicated that finding up-to-date trustworthy information was challenging. Most women preferred information provided by websites. Participants identified many fertility and childbearing concerns. The three main categories extracted from the interviews were "concerns about fertility potential," "pregnancy concerns," and "non-pregnancy reproductive concerns" (Table 2).

### 1. Concerns about Fertility Potential

One of the most repeated concerns of HPV-positive women was fear of fertility impairment in both male and female patients mostly expressed by younger women who had pregnancy plans.

#### 1. a. Adverse Effects of HPV on Male Fertility

Some participants had questions about the presence of the virus in semen, sperm, and penis skin. They showed concerns about the effect of HPV on male fertility.

*"We've been told to use a condom. Does this virus get into my husband's sperm? Isn't it weakening his fertility? I'm worried, it's because of this infection that I haven't got pregnant these years"*(P.10)

Women with mixed HPV types whose husbands had GWs were mainly concerned about the importance of removing warts before conception.

#### 1. b. Negative Effect of HPV on Female Fertility

Participants were anxious and needed more information about the effect of papillomavirus on hormones and the reproductive system.

*"You know why I'm worried? If I had a baby now, I wouldn't care about HPV. I'm 37. I have to get pregnant soon. I may lose my chance of getting pregnant. Does the virus affect my ovaries?"* (P.10)

Some expressed fear and anxiety about losing their fertility due to getting cancer following persistent high-risk HPV.

*I'm convinced that I am going to get cancer and I might never be able to have a baby in the future. I'm depressed because I'm not sure I can preserve my ability to get pregnant.” (P.7)*

Few women attributed the failure of assisted reproductive techniques (ART) to HPV.

*“We've been trying to conceive for six months with no luck. We did IUI (Intra Uterine Injection) twice. I asked my doctor; she said the virus could be in the semen.” (P.8)*

### **1. c. Threatened Female Fertility Association with Treatments and Vaccine**

Women were concerned that therapeutic procedures (cryotherapy, loop electrosurgical excision procedure (LEEP), and conization) might impact their ability to get pregnant. A single woman who was about to have LEEP surgery for her cervical intraepithelial neoplasia (CIN)-2, expressed her concern as follows:

*“I'm not sorry that I'm not getting married at all. I'm heartbroken that I don't know why, from the moment I find out [about HPV], I can feel ... how much I wanted to have a baby. They (doctors) say there may not be a problem with this operation [LEEP], but there's . It can narrow the cervix and make it hard to get pregnant . All of those things run through your head.” (P.12)*

A wife planning to get pregnant after a LEEP asked:

*“When can I start trying to conceive after a LEEP ?” (P.19)*

Few women were concerned about the potential effect of HPV vaccine on menstruation and fertility.

*“I was spotting and lethargic every time I was vaccinated. Does HPV vaccine affect the period? I've read on Instagram that HPV vaccine can cause infertility” (P.14)*

*“Can Gardasil shots cause missed periods?” (P.16)*

## **2. Pregnancy Concerns**

Pregnancy for women infected with HPV had some challenges, mostly over personal health. Participants also expressed worries about fetal harm and adverse pregnancy outcomes including miscarriage, preterm delivery and cesarean section.

### **2. a. Threatened Mother's health during pregnancy**

Most HPV-positive women with abnormal cytology results were anxious that weakening the immune system during pregnancy could lead to the virus persistence in their body, and worsen cervical abnormalities. This fear was so great that some who had decided to become pregnant soon changed their pregnancy plans, postponing them until their cytology and HPV results return to normal.

*“I wanted to get pregnant, so I went to a specialist for a checkup. Now that my test results [Pap, HPV, and colposcopy] came abnormal, I think it's not an appropriate time for me to get pregnant. I'm afraid pregnancy will make my results worse. I'm going to wait for the virus to go away, and then get pregnant.” (P.1)*

*“I wanted to get pregnant. Then it happened [high-risk HPV and ASC-US], and I can't think of pregnancy anymore. My doctor said I could get pregnant, but I'm afraid I'll get pregnant, and my immune system will go down, and then my abnormal cells will grow.” (P.6)*

Some participants expressed concern about the safety of diagnostic and therapeutic procedures during pregnancy. They were worried that becoming pregnant would deprive them of timely treatment.

*“Is colposcopy allowed in pregnancy? Could I be treated during pregnancy, if I get a serious precancerous condition?” (P.6)*

Women with mixed HPV genotypes worried about increasing their warts during pregnancy. These thoughts discouraged and frustrated them.

*“Pregnancy causes warts to multiply or get more noticeable. They're disgusting.” (P.2)*

They also had questions about preferred GWs treatments during pregnancy.

*"If I get warts, what treatments are available for pregnant women? Can I freeze it?"* (P.10)

## **2. b. Adverse Pregnancy Outcomes**

Most women planning to have children in the future were concerned about the implications of infection on their (potential) child. Women interviewed mentioned the association between genital HPV infection and various maternal and fetal variables and pregnancy complications such as miscarriage and premature delivery.

*"I had a miscarriage last year. Was it from this virus? My Pap smear was always normal. What if I get pregnant and have a miscarriage again?"* (P.4)

Women stated treatments like LEEP or conization might compromise their ability to carry a child to term by weakening the lining of the cervix.

*"My sister's doctor removed abnormal cells from her cervix. After that, she became pregnant and her baby was born in the 35th week."* (P.3)

Considering cesarean delivery for women with HPV was another matter posed by the participants. Some of them mistakenly believed that having genital warts was an indication of cesarean delivery to avoid perinatal development of laryngeal papillomatosis in the newborn.

*"My doctor said if I had warts, I'd have a cesarean section. Thank god I did not have warts and I gave birth naturally."* (P.2)

## **2. c. Harm to the Fetus**

Fetal health was the main concern about pregnancy raised by most women interviewed. Participants also reported that they often found it challenging to find adequate information about this issue. They needed to know what to do to protect their child from the infection. In this regard, one of the participants planning to get pregnant soon stated:

*"I worry about passing HPV to the baby during pregnancy and childbirth. What would I do to stop that?"* (P.4)

Since anogenital warts can proliferate during pregnancy, removal of warts during pregnancy was another issue that was raised. Women with GWs revealed information needs surrounding the teratogenicity of some wart-removing treatments. They felt anxious about any threats that might pose to the fetus.

*"Doctor gave me Podophyllin, saying I shouldn't get pregnant while using it. I'm afraid I'm pregnant. I want to know which wart-removing medicine is safe in pregnancy."* (P.4)

They also wanted to know if intercourse during pregnancy would increase the chance of HPV transmission to the fetus.

Almost all women interviewed reported being advised to take the HPV vaccine. Participants knew little about the safety of the HPV vaccine (mostly Gardasil) in pregnancy. Women who wanted to get pregnant preferred not to become pregnant until they completed the vaccine series.

*"I asked about vaccination and pregnancy. Doctor recommended postponing vaccination until after pregnancy. But I'd rather to get vaccinated first."* (P.2)

## **3. Non-Pregnancy Reproductive Concerns**

Some reproductive concerns unrelated to pregnancy have reported in the third category. Five challenges discussed in this category were breastfeeding, contraception method, premature menopause, cervical cancer, and familial cancer.

### **3. a. Fear of Infecting Newborn**

Two women mentioned the likelihood of passing HPV to a child through breast milk or early nursing.

*"Does HPV affect breast milk, I mean, just like a diet? Does breastfeeding cause mouth warts? Should we avoid breastfeeding?"* (P.3)

### 3. b. Concerns related to Contraception Method

To avoid unplanned pregnancies, women with HPV needed more information to choose preferable contraception. As long-term use of birth control pills increases the cervical cancer risk for women with persistent HPV, users recommended changing their contraception method. Women were worried about the negative impacts of combined oral contraceptives (COCs) and levonorgestrel (LNG) pills on their cellular changes.

*"We use the pull-out (withdrawal) to prevent pregnancy, but sometimes I use emergency pills. I don't know if they can weaken my immune system. I read online that birth pills may induce cervical cancer. Are the emergency pills as harmful as the OCPs?"* (P.17)

*"I've taken LD pills after my daughter was born, which is about nine years. They said I have to stop taking them. I don't know what to do. My husband does not use a condom."* (P.11)

Some women in a monogamous relationship reported they (or their husbands) are reluctant to use a condom. They wanted to know why using a condom is essential for HPV-positive patients when they already had HPV.

### 3. c. Fear of Premature Menopause

A few women over 40 who had no pregnancy intention mentioned concerns about early menopause. Testing positive for high-risk HPV genotypes and abnormal cytology have made these participants fearful of premature ovarian insufficiency.

*"I have noticed my periods becoming infrequent. I've tested positive for HPV 16. I feel that my periods get missed and irregular due to this disease. Could this virus cause me to menopause? I'm worried I'm in menopause. I don't like to get there."* (P.18)

Another stated: *"I had a hysterectomy last year (because of fibroids and heavy periods). They hadn't removed my ovaries. I also had a high-risk HPV 53, but I got vaccinated, I'm worried about the effect of HPV on my ovaries."* (P.15)

### 3. d. Fear of Cervical Cancer

One of the most common concerns of women tested positive for HPV was cervical cancer that has described in a different manuscript as the psychological response to HPV diagnosis. A context-specific finding that seems specific to societies that adhere to cultural principles was fear of cervical cancer in virgin single women. Since vaginal virginity is a matter of prestige in most parts of Iran, they reported engaging in sexual intercourse without vaginal penetration. Two virgin women have expressed concern about cervical cancer following an ascending HPV infection from the perineum to the cervix. After getting genital warts and learning about HPV-related cancers, they were worried about cervical cancer. One revealed that:

*"You don't know what is going on because you can't take Pap smear or colposcopy. I was scared. My gynecologist performed so-called Girly Pap smear. She took a cotton swab sample from the end of the vagina for HPV typing and cytology."* (P.16)

It was a

### 3. e. Fear of Familial Cancer due to HPV

Few women were anxious about the possible association between HPV and history of cancer in their female family members.

*"My sister had a mastectomy last year. I wonder her cancer was associated with HPV. We both have HPV. I'm scared what if it's a familial thing, and then I might get cancer too."* (P.9)

Another woman with CIN-2 and high-risk types mentioned:

*"My mother died of cancer. Did it have anything to do with HPV?"*(P.20)

## Discussion

### Main findings

The present study aimed to shed some light on the reproductive concerns of women infected with HPV and found they have reproductive concerns and informational needs over male and female fertility potential. Women expressed some pregnancy challenges like worries about harm to fetus, and adverse pregnancy outcomes, including miscarriage, preterm delivery, and cesarean section. Women in this study also reported concerns over non-pregnancy reproductive issues such as contraception, breastfeeding, and premature menopause. HPV-positive women with abnormal cytology results were anxious that becoming pregnant and taking hormonal contraception might worsen their health. Most married participants were reluctant to use a condom and wondered why HPV patients must use it. They also asked about the potential reproductive risks of the HPV vaccine.

### Strengths and limitations

In previous studies, the reproductive concerns of HPV-positive people had been discussed as a part of emotional and psychological responses to HPV diagnosis. Our findings are noteworthy because as far as we are aware, this is the only qualitative study in which reproductive concerns of HPV-positive women have received particular attention. Furthermore, women with diversity in HPV genotypes (both high-risk and low-risk) were interviewed. As queries about sexual health were part of the interview content, they will be discussed in another manuscript entitled "Sexual life of HPV-positive women." One of the limitations is that the study was conducted among women attending one colposcopy clinic. However, this referral clinic is likely to reflect other clinics in Iran since it covers a varied population. Possibly women who were interested in the topic decided to participate, and it applies to all qualitative research. Moreover, the relative weight or importance of themes and categories is not always apparent. The credibility of the process is demonstrated in the sentiments stated in the data set, suggesting that the extracted concerns may be transferrable to other settings. An additional strength is that this paper complies with the COREQ checklist designed for the reporting of qualitative studies (19).

### Interpretation

Our participants had questions and worries about the presence of HPV in the semen and the impact of HPV infection upon male fertility. Concern over subfertility in HPV-positive men has received far less attention in previous qualitative studies. The data support the presence of HPV in semen and its proposed role in decreased fertility (20, 21). Other studies indicated that HPV infection of semen represents a risk factor for male fertility abnormality (1, 3). A study found the most common HPV genotype among couples undergoing IVF treatment was 52 (1). Interestingly two of our participants (numbers 10 and 8) who were extremely concerned over infertility had genotype 52. Although this is not a correlational study, it can be suggested as an area for more research.

In line with our findings, various other studies also indicated HPV-positive women have concerns about female fertility impairment and the effects of HPV on childbearing and pregnancy outcomes (9, 10, 13, 22-24).

It is worth mentioning that HPV DNA has been detected in endometrium and ovaries (25). In a cohort study conducted in Denmark, no association had been found between high-risk HPV and the risk of female infertility (26). In a review, alluded to a relationship HPV had with alterations in fertility and ART outcomes (27). Accordingly, HPV detection and genotyping in both men and women are suggested in infertility diagnosis, at least in idiopathic infertility cases, before IVF procedures (27).

Two participants expressed worries about the relationship between infecting with HPV and the failure of ART. It is worth mentioning that in a study conducted in Belgium, indicated that HPV positivity is associ-

ated with a negative IUI outcome. HPV-positive women were six times less likely to become pregnant after IUI (28). Other studies found the detection of HPV at the time of fertility treatment has been adversely affected IVF outcomes, including lower pregnancy rates and increased risk of early pregnancy loss (29, 30). Since their concerns do not seem to be unfounded, it is suggested health care providers take these concerns seriously and consider referring them to specialists.

Our participants expressed their fear of losing fertility due to getting HPV-associated cancers in the future. Another study also reported similar concerns (9). In line with our findings, fertility concerns surrounding the HPV vaccine were reported in another study (12). It can be due to considerable media attention to the safety of the HPV vaccine. World Health Organization (WHO) indicated to a systematic review concluded no causal relationship between HPV vaccination and infertility (31). Caregivers can reassure women with these concerns by citing to the WHO.

As indicated by some other studies, fertility concerns surrounding conservative treatment for CIN have also mentioned by our participants (9, 12, 23). Women expressed fears about whether their fertility would be affected by HPV diagnostic and therapeutic procedures like LEEP and conization. Research has yielded mixed results, but at least one study indicates that fertility is not affected by a LEEP (32).

Pregnancy concerns were another main category extracted from the interview data. Women mentioned that worrying about the adverse effects of pregnancy on their health was the main reason they decided not to get pregnant. In a mixed-method study conducted in the United States, 30 of 94 women who planned on getting pregnant indicated that their HPV test results would change their future pregnancy plans (33). Physiological changes during pregnancy and a decline in the functions of the immune system may stimulate the progression of the HPV infection (34). Women infected with HPV needed to know what they need to do to have a healthy pregnancy. They may also face barriers seeking and obtaining information to address their reproductive concerns.

In the present study, the participants feared that the accidental injection of the HPV vaccine during pregnancy would cause harm to the fetus or adverse pregnancy outcomes. This fear surrounding the HPV vaccine may stem from the fact that drugs and medications theoretically might be damaging, especially in the first pregnancy trimester (35). Pregnancy testing before vaccination is not necessary although the vaccine manufacturers and WHO recommend avoiding HPV vaccination during pregnancy (35). Since no HPV vaccine-associated adverse events has been observed in pregnancy or immediately post-conception, in cases of unintentional immunization of pregnant women no intervention is needed (35). Unexpectedly, for protection against HPV, the vaccination of women is preferable before or eventually during pregnancy (25), but in a meta-analysis indicated that the association between peri-conceptual or pregnancy exposure of HPV vaccine and spontaneous abortion is still uncertain (36).

In line with our findings, two studies also indicated concerns about the association between HPV infection and adverse pregnancy outcomes such as spontaneous abortion and preterm delivery (9, 12). Scientific literature states that HPV infection in females is associated with spontaneous abortion and preterm birth (3, 27, 28, 37). Adequately, HPV positivity in pregnant women or their partners can be considered as a risk of miscarriages and premature rupture of membrane (3, 27). Two studies indicated that the cervical conization and a LEEP do not necessarily increase the risk of preterm delivery in a subsequent pregnancy (38, 39).

Women interviewed thought natural childbirth may pose a transmission risk to a newborn. Another qualitative study reported this concern (12). Tseng et al. found the overall frequency of HPV transmission from mothers to neonates was 39.7%, and a meaningfully higher rate of infection was observed when infants were delivered vaginally compared with cesarean (40).

Most participants reported being highly concerned about the safety of wart-removing medications and diagnostic and therapeutic interventions for cervical cell changes during pregnancy. They asked about the safest way to remove GWs. In a study, CO<sub>2</sub> laser vaporization has been suggested as a safe, simple treatment for warts during pregnancy (41).

In line with Pourmohsen, maternal-to-fetal HPV transmission was a common concern, especially among married who had the pregnancy plans. There is still much controversy about the precise mode of and the clinical effects of infection on the child. Detection of HPV DNA in semen, endometrium, and ovaries indicates the possibility of transmission even before conception. It raises the possibility of a child's parents as the potential sources of HPV infection (25, 42). Another possible route of infection is intrauterine or prenatal transmission; because of the reported presence of HPV DNA in the amniotic fluid, placenta, and cord blood samples. Close contact of the fetus with the infected cervical and vaginal tracts of the mother during delivery can cause perinatal transmission. Maternal history of genital warts in pregnancy was associated with a higher risk of respiratory papillomatosis in the child (43). Horizontal HPV transmission during breastfeeding or early nursing has also been considered as a significant contributor toward the infant's contagion. Two participants expressed such concerns. Inconsistent results have been found in terms of breast milk as a potential reservoir of viruses (25). In light of lifelong HPV protection, considering the vaccination of infants is suggested (25).

Almost all interviewed women had been recommended to use a condom. Most married reported that they (or their husbands) are reluctant to use a condom. They wanted to know why constantly using condoms is essential while they already are HPV-infected. Caregivers should also explain why they recommend using a condom.

Some women with a history of taking hormonal contraceptives pointed out they have been recommended to stop taking combined hormonal pills. HPV-positive women raise some concerns about choosing their contraceptive method. Long-term use of birth control pills increases cervical cancer risk, importantly for women with persistent HPV infection. However, users of combined oral contraceptives (COCs) have a decrease in immune cells providing a favorable environment for the appearance of HPV lesions (44). Although, to conclude causality, more studies are needed (44), particular attention should be given to discuss contraception methods with HPV-positive women.

Such richness from the interviews revealed unexpected concerns such as fear of having an ovarian tumor and getting cancer because of a family history of cancer. They considered HPV to be a familial carcinogen factor. Similar concerns indicated by another study (8).

The only context-specific finding was the fear of cervical cancer in single virgin women. To reassure these women, doctors take a so-called "Girly Pap smear" from the upper part of the vagina with a cotton swab.

## Conclusions

The findings of this qualitative study suggest women's concerns about fertility and childbearing need to be taken into account when medical professionals are counseling HPV-positive women. These extracted concerns may change the way clinicians manage HPV infection. Medical professionals need to take women's informational needs more seriously in designing educational interventions to become one step closer to helping these women meet their long-term reproductive goals and improve their reproductive health outcomes. Women identified a need for information about these sensitive topics so that they can make informed decisions about having children. Some women may also benefit from referral to a specialist in the context of assisted reproduction. Women found it challenging to access reliable, relevant, and timely information. Moreover, health care providers may lack knowledge about the impact of HPV on both male and female reproductive capacity. They could benefit from additional training to be prepared for supporting women experienced reproductive concerns.

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## Disclosure of Interests

The authors have no conflict of interest.

## Contribution to Authorship

KQ, STM, MG, FF, and SHSH designed the study. KQ conducted the interviews. STM and KQ planned and undertook the analysis. KQ wrote the initial and subsequent drafts of the manuscript. STM, MG, FF, and SHSH contributed to revising the manuscript. All authors have approved the final manuscript.

### Details of Ethics Approval

This study was reviewed and approved by the Ethics Committee of Tehran University of Medical Sciences (IR.TUMS.FNM.REC.1397.139).

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## Tables

**Table 1.** Demographic characteristics, HPV genotypes and cytology results of participants

Participant ID number	Age (years)	Socio-economic level	HPV Genotyping	Cervical Cytology	Education	Occupation	Marriage duration (years)	Number of children	HPV du (m
1 Mina	32	High	High-risk	CIN-1	PhD	Lecturer	9	1	2
2 Eli	31	Middle	Mixed	CIN-1	Bachelor	Housewife	3	1	24

Participant ID number	Age (years)	Socio-economic level	HPV Genotyping	Cervical Cytology	Education	Occupation	Marriage duration (years)	Number of children	HF du (m
3 Razieh	30	Middle	High-risk	Normal	Master	Teacher	3	0	2
4 Inaz	28	High	Mixed	Normal	Bachelor	Employee	3	0	1
5 Goli	39	Middle	Mixed	CIN-2	Bachelor	Hair-dresser	10	1	24
6 Samira	32	Low	High-risk	ASC-US	Bachelor	Nurse	11	1	3
7 Nazanin	23	Low	Mixed	Normal	Bachelor	Student	2	0	12
8 Ida	30	Middle	High-risk	Normal	Diploma	Housewife	6	0	12
9 Bita	28	Low	High-risk	Normal	Bachelor	Student	Single	0	3
10 Mehri	37	Middle	Mixed	Normal	Diploma	Housewife	7	0	12
11 Hanieh	32	Low	High-risk	CIN-1	Bachelor	Employee	10	1	2
12 Shirin	33	Middle	High-risk	CIN-2	PhD	Employee	single	0	6
13 Sara	44	Low	High-risk	ASC-US	Diploma	Housewife	23	3	13
14 Shadi	35	High	Mixed	ASC-US	Diploma	Housewife	Divorced	0	6
15 Kajal	47	Low	High-risk	CIN-2	High-School	Housewife	27	2	36
16 Donya	24	Low	Mixed	Normal	Bachelor	Shopkeeper	single	0	2
17 Flor	42	Middle	Mixed	ASC-US	Diploma	Housewife	20	2	12
18 Leila	41	High	High-risk	CIN-1	Master	Teacher	Widow	2	12
19 Neda	36	High	High-risk	CIN-2	Master	Employee	9	1	5
20 Bahar	35	High	High-risk	CIN-2	Bachelor	Musician	Divorced	1	1

Participant ID number	Age (years)	Socio-economic level	HPV Genotyping	Cervical Cytology	Education	Occupation	Marriage duration (years)	Number of children	HPV du (m
CIN: Cervi- cal In- traep- ithelial Neo- plasia Mixed: Both high- risk and low- risk HPV geno- types ASC- US: Atypi- cal Squa- mous Cells of Unde- ter- mined Significance	CIN: Cervi- cal In- traep- ithelial Neo- plasia Mixed: Both high- risk and low- risk HPV geno- types ASC- US: Atypi- cal Squa- mous Cells of Unde- ter- mined Significance	CIN: Cervi- cal In- traep- ithelial Neo- plasia Mixed: Both high- risk and low- risk HPV geno- types ASC- US: Atypi- cal Squa- mous Cells of Unde- ter- mined Significance	CIN: Cervi- cal In- traep- ithelial Neo- plasia Mixed: Both high- risk and low- risk HPV geno- types ASC- US: Atypi- cal Squa- mous Cells of Unde- ter- mined Significance	CIN: Cervi- cal In- traep- ithelial Neo- plasia Mixed: Both high- risk and low- risk HPV geno- types ASC- US: Atypi- cal Squa- mous Cells of Unde- ter- mined Significance	CIN: Cervi- cal In- traep- ithelial Neo- plasia Mixed: Both high- risk and low- risk HPV geno- types ASC- US: Atypi- cal Squa- mous Cells of Unde- ter- mined Significance	CIN: Cervi- cal In- traep- ithelial Neo- plasia Mixed: Both high- risk and low- risk HPV geno- types ASC- US: Atypi- cal Squa- mous Cells of Unde- ter- mined Significance	CIN: Cervi- cal In- traep- ithelial Neo- plasia Mixed: Both high- risk and low- risk HPV geno- types ASC- US: Atypi- cal Squa- mous Cells of Unde- ter- mined Significance	CIN: Cervi- cal In- traep- ithelial Neo- plasia Mixed: Both high- risk and low- risk HPV geno- types ASC- US: Atypi- cal Squa- mous Cells of Unde- ter- mined Significance	CIN: Cervi- cal In- traep- ithelial Neo- plasia Mixed: Both high- risk and low- risk HPV geno- types ASC- US: Atypi- cal Squa- mous Cells of Unde- ter- mined Significance

**Table 2:** Extracted categories and sub-categories from the interview data

Example of codes	Sub-categories	Categories
-Ambiguity about the effect of the virus on male fertility -Asking about the need for male GWs' treatment before conception	a. Adverse Effects of HPV on Male Fertility	<b>1. Concerns about Fertility potential</b>
-The effects of HPV on reproductive hormones and menstrual cycle -Concerns about infertility due to persistent high-risk HPV and subsequent cancer -Attributing the failure of assisted reproductive techniques (ART) to the HPV	b. Negative Effect of HPV on Female Fertility	

Example of codes	Sub-categories	Categories
-Fear of Cervical infertility following invasive treatments (cryotherapy, LEEP, and conization) -The impact of the vaccine on hormones and the menstrual cycle -Fear of Infertility following HPV Vaccination	c. Threatened Female Fertility Association with Treatments and Vaccine	<b>2. Pregnancy Concerns</b>
-Concerns about Increasing Genital Warts during pregnancy -Worrying about weakening immune system during pregnancy -Limitation of performing diagnostic and therapeutic interventions (colposcopy-biopsy) in pregnancy -Postponing pregnancy for fear of progression of the disease	a. Threatened Mother’s health during pregnancy	
-Fear of miscarriage due to HPV -Concerns about preterm birth due to HPV -Performing the cesarean section due to HPV	b. Adverse Pregnancy Outcomes	
-Fear of Negative effects of GWs’ Medications on the fetus -Concerns about the Safety of HPV Vaccine in pregnancy -Fear of Transferring HPV to the fetus	c. Harm to the Fetus	
-Worrying about infecting the infant via breast milk and nursing	a. Fear of Infecting Newborn	
-Not using condom -Worries about the Negative effect of Hormonal contraception on Abnormalities -Need to a safe method of contraception	b. Concerns related to Contraception Method	<b>3. Non-Pregnancy Reproductive Concerns</b>
-Concerns about the effect of the virus on premature menopause	c. Fear of Premature Menopause	
-Attributing Family history of Gynecologic Cancer to HPV	d. Fear of Cervical Cancer	
-Fear of Cervical Cancer following HPV infection	e. Fear of Familial Cancer due to HPV	

## Appendix 1

### Interview guide:

”What do you know about HPV?”, ”What have you been told or what do you know about the effects of HPV on the reproductive system of both men and women?”, ”Please tell me about your experiences, thoughts, and feelings regarding pregnancy and childbearing?”, ”Are you experiencing any concerns?”, ”How do you describe pregnancy and motherhood while infecting with HPV?”, ”Is your personal pregnancy plan affected

by the diagnosis? And how?”, and “What you need to know as a woman infected with HPV about your reproductive health (menstrual cycle, marriage, contraception, pregnancy, breastfeeding, menopause, and gynecological cancers)?”, “How you seek for answer to your questions?” and “Which source of information do you prefer? And why?” Open questions such as “What do you mean?” and “Please expand” were used to extract more clear and detailed responses.