Human Papillomavirus and Chlamydia trachomatis in oral and genital mucosa of women with normal and abnormal cervical cytology

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Research Article

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Abstract

Background. STI such as HPV and *C.trachomatis* are important to public health, because of the high risk of asymptomatic genital or oral infections could lead to complications and coinfections may be an important cofactor for the oncogenic transformation.

Objective. Evaluate the prevalence of oral and genital HPV and *C.trachomatis* infection in women with normal and abnormal cervical cytology.

Study design. The cross-sectional study included 200 oral and cervical swabs from 50 women with normal and 50 with abnormal cervical cytology. HPV and *C.trachomatis* infections were detected using PCR with specific primers.

Results. HPV DNA was detected in 27% of women with normal and abnormal cytology. Out of 27 we detected HPV DNA in 18% of genital samples and 14% of oral samples. HPV genotypes detected were genotype 6 of low-risk and 16, 31, 52, 58 and 16-31 coinfection of high-risk. *C.trachomatis* DNA was detected in 49% of patients, out of 49 we detected *C.trachomatis* in 35% of genital samples and 31% of oral samples. There is statistically significant ($p<0.05$) between cytology and HPV and *C.trachomatis* infection but there is no statistically significant between cytology and the other characteristics.

Conclusions. The morphological similarity between oropharyngeal and genital epithelia would allowed us to infer that the infection in one of this mucosa could occur in the other. Therefore, is important *C.trachomatis* detection and specific treatment in asymptomatic women because it is known that may increase the risk of HPV persistence and coinfection induces a pro-inflammatory environment that may promote the carcinogenesis. This study highlight the importance of identified possible cofactors for oncogenesis.

Introduction

Human Papillomavirus (HPV) and *Chlamydia trachomatis* (*C.trachomatis*) are the most frequent, viral and bacterial respectively, sexually transmitted infections (STIs) worldwide and HPV is the necessary but no sufficient cause for cervical cancer [1]. Coinfections may be an important cofactor for the oncogenic transformation. There is evidence that *C.trachomatis* could act as a cofactor which facilitates HPV infection and contributes to the viral persistence, increasing the risk of developing cervical neoplasia [2, 3]. While screening strategies exist for cervical cancer prevention and the vaccination programs started, there is a lack of policies for the control of *C.trachomatis* infection [4]. *C.trachomatis* can cause different diseases such as cervicitis, endometritis, pelvic inflammatory disease and ectopic pregnancy [5].

Despite the well-established role of HPV in cervical cancer, evidence suggest that HPV may also be an independent risk factor for oral cancer [6] and it is proposed that *C.trachomatis* may be a cofactor for HPV associated oropharyngeal cancer [3, 7]. A potential correlation between genital and oral STIs suggests that oral sex may be the link to transmission from cervical to oral site [8]. Many factors are

associated with HPV infection, such as age, tobacco, alcohol, bacterial and viral infections, number of sexual partners, pregnancies, oral and anal sex [3, 9].

In view of these data, the present cross-sectional study aimed to evaluate the prevalence of oral and genital HPV and *C.trachomatis* infection in women with normal and abnormal cervical cytology.

Materials And Methods

Study population. The cross-sectional study included oral and cervical swabs from 50 women with normal cervical cytology and 50 women with abnormal cervical cytology (Bethesda criteria), who had been referred to Maternity and Neonatology University Hospital- Argentina. Immunocompromised women were excluded. Patients included in the study, signed an informed consent form.

Data and sample collection. A short questionnaire was used to collect data about age, number of sexual partners, oral and anal sex, number of pregnancies, history of STIs, oral lesion, contraceptive method, tobacco use and HPV vaccine.

The total number of cigarettes smoked throughout the patient's life was calculated considering smoker to the person who smoked more than 100,000 units [10].

Cervical swabs were collected by a gynecologist using a brush and oral swabs were collected by a dentist.

Ethical approval. This study was approved by the Committee of Ethics, National Hospital of Clinics-Argentina (RePIS2548) according to the ethical principles stated in the declaration of Helsinki.

HPV and *C.trachomatis* detection. DNA was extracted using the commercial AccuPrep Genomic DNA Extraction Kit-Bioneer, following the manufacturer's instructions. HPV L1 genomic region (450bp) was amplified with degenerate primers MY09 and MY11 following Manos´s protocol [11]. HPV-DNA positive samples were typed by restriction fragment length polymorphism method, using 7 restriction enzymes (BamHI, DdeI, HaeIII, HinfI, PstI, RsaI and Sau3AIII) [12]. *C.trachomatis* was detected using CTP1 and CTP2 primers to cryptic plasmid (201 bp) [13]. The PCR products were visualized by electrophoresis in 1.5% agarose. The β-globin gene was used as DNA preservation marker.

Statistical analysis. Results were analyzed using Chi-square (X^2) and Fisher Exact with a significance level 5% (95% CI), Epi info 3.5.4, CDC software (2012).

Results

We studied 100 women who used the public health service, the women age range 18- 67 years (mean 39). These women were divided according to normal and abnormal cytopathological findings. Normal papapanicolaou test include infections and inflammation and abnormal results includes atypical squamous cells of undetermined significance (ASCUS), low-grade squamous intraepithelial lesion (LSIL)

and high-grade squamous intraepithelial lesion (HSIL) according to Bethesda system[14]. The normal group (NG) comprised 50 women who presented inflammatory cytology, whereas the abnormal group (AG) comprised 50 women, 9 with HSIL and 41 with LSIL. Table 1 shows the demographic, clinical, and molecular findings, and the relationship between the normal and abnormal status of the women in this study.

There is no statistically significant between cytology and age, number of sexual partners, oral sex, anal sex, pregnancies, history of ITSs, use of contraceptive methods and tobacco ($p>0.05$). Reference to HPV vaccine, all women were asked about this, but only one of them was vaccinated (AG, negative to HPV and *C.trachomatis*). However, in AG, women upper 38 years old had a higher rate of abnormal cytology. Concerning history of ITSs, 2 patients with normal cytology had a history of *Trichomonas vaginalis* and Herpes Simplex Virus (HSV) infection. While in patients with abnormal cytology, 2 of them had a history of *C.trachomatis*, 1 of them HSV and 1 had history of *Treponema pallidum*.

A total of 200 samples were studied, oral and cervical swabs were collected from each woman. HPV DNA was detected in 27% of women (27/100) with normal and abnormal cytology (Table 1). Out of 27 patients (Figure 1) we detected HPV DNA in 18% (18/100) of genital samples and 14% (14/100) of oral samples (5 patients with both mucosa infected- 3 NG and 2 AG). There is no statistically significant between genital and oral HPV detection ($p=0,888$). HPV genotypes detected were genotype 6 of low-risk and genotypes 16, 31, 52, 58 and 16-31 coinfection of high-risk. A total of 10 samples HPV DNA positive were genotype not identified. The more frequent genotype was the type 16 in normal and abnormal cytology as well as oral and genital mucosa. The only HPV type detected in oral mucosa was 16 (Figure 2). Out of 5 women with oral and genital HPV, the same genotype was detected in 3 of them, all HPV 16. Two of them were not possible to obtain the genotype in one mucosa.

C.trachomatis DNA was detected in 49% of patients (Table 1), out of 49 patients (Figure 1) we detected *C.trachomatis* in 35% (35/100) of genital samples and 31% (31/100) of oral samples (17 patients with both mucosa infected- 8 NG and 9 AG). There is no statistically significant between genital and oral *C.trachomatis* detection ($p=0,732$).

HPV was detected more frequent in NG (36%) in comparison with AG (18%), and in the different way *C.trachomatis* was detected more frequent in AG (60%) in comparison with NG (38%). There is statistically significant ($p<0.05$) between cytology and HPV and *C.trachomatis* infection (Table 1).

We detected 14 (14%) patients with the two infections, HPV and *C.trachomatis* (Table 2). Out of 14 patients, 7 had normal cytology and 7 had abnormal cytology.

Discussion

Sexually transmitted microorganisms, such as HPV and *C.trachomatis* are asymptomatic infections in approximately 90% and 80% of women worldwide respectively and they could produce persistent infection and progress to cervical cancer [15]. Therefore, potential mechanisms have been hypothesized

about this coinfection: *C.trachomatis* infection may lead to epithelial disruption and facilitate HPV entry, or it can affect the immune response favoring the persistence of HPV [16].

When cervical HPV infection is investigated, different sites such as the oral cavity is not investigated, except in the presence of visible lesions, as well neither *C.trachomatis* infection [17]. The frequency of *C.trachomatis* in the oral cavity varies widely among published studies. This variability can be explained by the varied biological samples, the lack of global standardization techniques and the diversity of population study groups [18,19].

Although knowledge of HPV related tumor is clear, the prevalence of oropharyngeal HPV and *C.trachomatis* infection in unclear [8,17]. Both microorganisms are important to public health, because of the high risk of asymptomatic genital or oral infections could lead to complications like cervical and/or oral cancer [16].

The present results showed a prevalence of 27% for HPV, 14% for oral mucosa. In reference to oral HPV, in asymptomatic patient is still a matter of debate. Kreimer reported that asymptomatic oral HPV 16 infection was found in 1.3% [20] and Ciccarese detected 37% oral HPV DNA in women without signs of HPV infection [21]. In a previous local study, HPV was not detected in oral mucosa without lesion or injury [9]. Likewise, in a study conducted in the same region among randomly selected healthy subjects, HPV was detected in 3% (13/401) and all the identified genotypes were low risk [22]. So, our prevalence detected is higher than previous studies. Other study conducted by our group, detected 34% of oral HPV in patients with oral lesions [3], while in this present study only one patient had visible oral lesion. However, the absence of clinical signs of lesions in the oral cavity could show a subclinical infection which can be transmitted [17].

For *C.trachomatis*, our results show a prevalence of 49%, 31% in oral mucosa. These results are higher in comparison with other study conducted by our group, in which we detected 17% *C.trachomatis* DNA positive in oral lesions [3]. Our results are similar to a study from Japanese population, in which 44% of *C.trachomatis* was detected in pharyngeal smears and 61% in oral fluid in sex workers [18]. This frequency was higher too than a study conducted in the Netherlands, which pharyngeal *C. trachomatis* was detected in 2.3% of women [19]. A review that described extra genital *C.trachomatis* infections, showed a prevalence of 0.2 to 3.2% in pharyngeal swabs from asymptomatic women [23].

In reference to cytology status, we found a HPV detection rate of 36% in women with normal cytology and more prevalent in genital area. These results are in concordance with a study published from Brazil in which a prevalence of 36.09% was detected in women with normal cytology [24] and lower than other study, in which the prevalence of genital HPV in normal cytology was 49%. Patients with normal cytology tests and HPV HR types must be followed up because are at a high risk of having HPV induced lesions in the future[14]. In women with abnormal cytology we detected 18% HPV DNA positive, surprisingly prevalence lower than women with normal cytology but in agreement with Ji, who detected 18.4% HPV in abnormal cytology [5]. To difference with our results, Beyazit detected 51% of genital HPV [14],

Ssedyabane 63.4% [25] and a local study conducted by Venezuela detected 51.6% in women with abnormal cytology [26].

Although HPV18 genotype is the second more frequent high risk type detected worldwide, in this study, we not detected HPV18 genotype in genital as well as oral mucosa. This is in agreeing with previous studies in oral mucosa in Argentina [3,9,22,27]. Reference to genital mucosa, the Brazilian study not detected HPV18 genotype in normal mucosa [1,24]. The more frequent HPV genotype detected was type 16; this result is in concordance with others studies in oral as well as genital mucosa [3,5,9,14,22,24,26,27]. The coinfection detected in this work was high risk genotypes 16 and 31 in genital mucosa. However, previous reports suggest that HPV genotypes coinfection do not increase the risk of acquiring a new infection but may impair the immune response [5].

We detected a *C.trachomatis* prevalence of 38% in women with normal cytology and 60% in abnormal cytology, being more frequent in genital area. These results are in concordance with a study from India, which detected more prevalence of *C.trachomatis* in patients with abnormal cytology (31.5%) in comparison with normal cytology (5.8%) [28]. On the other hand, other studies showed different results, such as local studies: Jordá, detected 8.5% *C.trachomatis* prevalence in symptomatic and asymptomatic women [29] and Kiguen, 6.9% in pregnant women [30], all results lower than our prevalence detected. Other studies, conducted by Ji, detected similar prevalence of *C.trachomatis* in women with normal and abnormal cytology, 7.1% and 7.2%, respectively [5] and Costa Lira, detected to genital *C.trachomatis* in 9.02% [24]. Asymptomatic women are untested for *C.trachomatis* so this may account for the high number of positive women in our study.

Conclusions

The current study showed an association between cytology status and HPV and *C.trachomatis* infection, although HPV was more frequent in normal cytology. Therefore, is important *C.trachomatis* detection and specific treatment in asymptomatic women to prevent future sequelae. However, it is known that *C.trachomatis* infection may increase the risk of HPV persistence and coinfection induces a pro-inflammatory environment that may promote the carcinogenesis [4]. In the present work, HPV/*C.trachomatis* coinfection was found in 14%, predominantly in genital mucosa. This result is in concordance to Costa Lira, who detected 12.5% of coinfection in cervical swabs of the women studied [24]. The presence of the pathogens in two anatomic sites could be for genetic predisposition or altered immune response. So, the viral concordance between the two anatomical sites appears not to be obligatory [17].

There are a lot of risk factors for STIs, specially for cervical lesions [6], however, in this study we not detected statistically significance between cytology status and the different risk factors studied.

This study highlight the importance of HPV diagnosis and the sexually transmitted pathogens such as *C.trachomatis*, identified as possible cofactors for oncogenesis. In addition, bacterial infections detected on time could be reducing the risk to high lesion progression and because 90% of infected women with

C.trachomatis are asymptomatic, can have serious consequences for both reproductive and fetal health. *C.trachomatis* is a potential HPV cofactor due to possibility of concomitant infection, similar epithelium tropism and transmission, asymptomatic infection and persistence if untreated, which can produce epithelial damage facilitating HPV entry, inhibition of apoptosis, E6/E7 HPV oncogenes overexpression and cell transformation [28]. There is evidence that suggest screening for *C.trachomatis* is cost effective when its prevalence is above 3% [31]. These results promote us to continue with investigation of important processes to patient health.

Abbreviations

HPV: Human Papillomavirus

C.trachomatis: Chlamydia trachomatis

STI: Sexually Transmitted Infections

PCR: Polymerase Chain Reaction

DNA: Deoxyribonucleic Acid

Bp: base pairs

ASCUS: atypical squamous cells of undetermined significance

LSIL: low-grade squamous intraepithelial lesion

HSIL: high-grade squamous intraepithelial lesion

NG: normal group

AG: abnormal group

Declarations

Ethics approval and consent to participate: This study was approved by the Committee of Ethics, National Hospital of Clinics- Argentina (RePIS2548) according to the ethical principles stated in the declaration of Helsinki. All patients included in the study, signed an informed consent form.

Consent for publication: All data of this study are anonymous and we do not use patient name to publish.

Availability of data and materials: The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Competing interests: The authors declare no competing interest.

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Authors' contributions: JPM contributed with samples processing, data analysis and to the writing of the manuscript. CGC and OR designed the study, revised and approved the article to be submitted. SZ contributed with the samples collection and patient's data. AXK and RFV contributed with data analysis and drafting the article.

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References

1. Zur Hausen H. The search for infectious causes of human cancers: where and why. Virology. 2009;392(1):1-10.
2. Nonato DR, Alves RR, Ribeiro AA, Saddi VA, Segati KD, Almeida KP, et al. Prevalence and factors associated with coinfection of human papillomavirus and Chlamydia trachomatis in adolescents and young women. American journal of obstetrics and gynecology. 2016;215(6):753 e1- e9.
3. Mosmann JP, Talavera AD, Criscuolo MI, Venezuela RF, Kiguen AX, Panico R, et al. Sexually transmitted infections in oral cavity lesions: Human papillomavirus, Chlamydia trachomatis, and Herpes simplex virus. Journal of oral microbiology. 2019;11(1):1632129.
4. Bianchi S, Boveri S, Igidbashian S, Amendola A, Urbinati AM, Frati ER, et al. Chlamydia trachomatis infection and HPV/Chlamydia trachomatis co-infection among HPV-vaccinated young women at the beginning of their sexual activity. Archives of gynecology and obstetrics. 2016;294(6):1227-33.
5. Ji Y, Ma XX, Li Z, Peppelenbosch MP, Ma Z, Pan Q. The Burden of Human Papillomavirus and Chlamydia trachomatis Coinfection in Women: A Large Cohort Study in Inner Mongolia, China. The Journal of infectious diseases. 2019;219(2):206-14.
6. Syrjanen S. Oral manifestations of human papillomavirus infections. European journal of oral sciences. 2018;126 Suppl 1:49-66.
7. Jenkins WD, LeVault K, Sutcliffe S. Chlamydia trachomatis infection: possible cofactor for oropharyngeal cancer development? Oral oncology. 2015;51(2):e8-9.
8. Eggersmann TK, Sharaf K, Baumeister P, Thaler C, Dannecker CJ, Jeschke U, et al. Prevalence of oral HPV infection in cervical HPV positive women and their sexual partners. Archives of gynecology and obstetrics. 2019;299(6):1659-65.
9. Venezuela RF, Talavera AD, Frutos MC, Kiguen AX, Monetti MS, Sollazo M, et al. Human Papillomavirus (HPV) in oral cavity lesions: comparison with other oral cancer risk factors. J Microbiol Res. 2013(3):228-33.
10. Biondi K, Belloni S, Velasco M, Robledo G, Gallardo Femopase F, Lanfranchi H. Correlation between oral precancer and cancer and tobacco. J Dental Res. 1998;77(5):1118-

11. Manos MM. The use of polymerase chain reaction amplification for the detection of genital human papillomavirus. Cancer Cell. 1989;7:209-14.
12. Bernard HU, Chan SY, Manos MM, Ong CK, Villa LL, Delius H, et al. Identification and assessment of known and novel human papillomaviruses by polymerase chain reaction amplification, restriction fragment length polymorphisms, nucleotide sequence, and phylogenetic algorithms. The Journal of infectious diseases. 1994;170(5):1077-85.
13. Lan J, Walboomers JM, Roosendaal R, van Doornum GJ, MacLaren DM, Meijer CJ, et al. Direct detection and genotyping of Chlamydia trachomatis in cervical scrapes by using polymerase chain reaction and restriction fragment length polymorphism analysis. Journal of clinical microbiology. 1993;31(5):1060-5.
14. Beyazit F, Silan F, Gencer M, Aydin B, Paksoy B, Unsal MA, et al. The prevelance of human papillomavirus (HPV) genotypes detected by PCR in women with normal and abnormal cervico-vaginal cytology. Ginekologia polska. 2018;89(2):62-7.
15. Mitra A, MacIntyre DA, Marchesi JR, Lee YS, Bennett PR, Kyrgiou M. The vaginal microbiota, human papillomavirus infection and cervical intraepithelial neoplasia: what do we know and where are we going next? Microbiome. 2016;4(1):58.
16. Di Pietro M, Filardo S, Porpora MG, Recine N, Latino MA, Sessa R. HPV/Chlamydia trachomatis co-infection: metagenomic analysis of cervical microbiota in asymptomatic women. The new microbiologica. 2018;41(1):34-41.
17. Cossellu G, Fedele L, Badaoui B, Angiero F, Farronato G, Monti E, et al. Prevalence and concordance of oral and genital HPV in women positive for cervical HPV infection and in their sexual stable partners: An Italian screening study. PloS one. 2018;13(10):e0205574.
18. Hamasuna R, Hoshina S, Imai H, Jensen JS, Osada Y. Usefulness of oral wash specimens for detecting Chlamydia trachomatis from high-risk groups in Japan. International journal of urology : official journal of the Japanese Urological Association. 2007;14(5):473-5.
19. van Rooijen MS, van der Loeff MF, Morre SA, van Dam AP, Speksnijder AG, de Vries HJ. Spontaneous pharyngeal Chlamydia trachomatis RNA clearance. A cross-sectional study followed by a cohort study of untreated STI clinic patients in Amsterdam, The Netherlands. Sexually transmitted infections. 2015;91(3):157-64.
20. Kreimer AR, Bhatia RK, Messeguer AL, Gonzalez P, Herrero R, Giuliano AR. Oral human papillomavirus in healthy individuals: a systematic review of the literature. Sexually transmitted diseases. 2010;37(6):386-91.
21. Ciccarese G, Herzum A, Rebora A, Drago F. Prevalence of genital, oral, and anal HPV infection among STI patients in Italy. Journal of medical virology. 2017;89(6):1121-4.
22. Criscuolo MI, Belardinelli P, Morelatto R, Mosmann JP, Venezuela RF, Kiguen AX, et al. Prevalence of oral human papillomavirus (HPV) in the adult population of Córdoba, Argentina. Transl Res Oral Oncol 2018(3):1-8.

23. Chan PA, Robinette A, Montgomery M, Almonte A, Cu-Uvin S, Lonks JR, et al. Extragenital Infections Caused by Chlamydia trachomatis and Neisseria gonorrhoeae: A Review of the Literature. Infectious diseases in obstetrics and gynecology. 2016;2016:5758387.
24. Costa-Lira E, Jacinto A, Silva LM, Napoleao PFR, Barbosa-Filho RAA, Cruz GJS, et al. Prevalence of human papillomavirus, Chlamydia trachomatis, and Trichomonas vaginalis infections in Amazonian women with normal and abnormal cytology. Genetics and molecular research : GMR. 2017;16(2).
25. Ssedyabane F, Amnia DA, Mayanja R, Omonigho A, Ssuuna C, Najjuma JN, et al. HPV-Chlamydial Coinfection, Prevalence, and Association with Cervical Intraepithelial Lesions: A Pilot Study at Mbarara Regional Referral Hospital. Journal of cancer epidemiology. 2019;2019:9092565.
26. Venezuela RF, Kiguen AX, Frutos MC, Cuffini CG. Circulation of human papillomavirus (HPV) genotypes in women from Cordoba, Argentina, with squamous intraepithelial lesions. Revista do Instituto de Medicina Tropical de Sao Paulo. 2012;54(1):11-6.
27. Criscuolo MI, Morelatto RA, Belardinelli PA, Mosmann JM, Cuffini C, Lopez de Blanc SA. Oral Human Papillomavirus: a multisite infection. Medicina oral, patologia oral y cirugia bucal. 2020;25(3):e425-e30.
28. Madaan N, Pandhi D, Sharma V, Bhattacharya SN, Guleria K, Mishra K, et al. Association of abnormal cervical cytology with coinfection of human papillomavirus and Chlamydia trachomatis. Indian journal of sexually transmitted diseases and AIDS. 2019;40(1):57-63.
29. Jorda GB, Hanke SE, Ramos-Rincon JM, Mosmann J, Lopez ML, Entrocassi AC, et al. [Prevalence and phylogenetic analysis of Chlamydia trachomatis in a population of women in Posadas, Misiones]. Revista espanola de quimioterapia: publicacion oficial de la Sociedad Espanola de Quimioterapia. 2018;31(1):21-6.
30. Kiguen AX, Marrama M, Ruiz S, Estofan P, Venezuela RF, Mosmann JP, et al. Prevalence, risk factors and molecular characterization of Chlamydia trachomatis in pregnant women from Cordoba, Argentina: A prospective study. PloS one. 2019;14(5):e0217245.
31. Robial R, Longatto-Filho A, Roteli-Martins CM, Silveira MF, Stauffert D, Ribeiro GG, et al. Frequency of Chlamydia trachomatis infection in cervical intraepithelial lesions and the status of cytological p16/Ki-67 dual-staining. Infectious Agents and Cancer. 2017;12:3.

Tables

Table 1. Characteristics of patients studied according normal and abnormal cytology status.

		Normal cytology		Abnormal cytology		
	N	N	%	N	%	p-value
Total	100	50	100	50	100	
Age (years)						0.516
18-27	2	1	2.0	1	2.0	
28-37	42	25	50.0	17	34.0	
38-47	40	15	30.0	25	50.0	
48-57	12	7	14.0	5	10.0	
58-67	4	2	4.0	2	4.0	
Number of sexual partners						0.450
1 to 5	84	44	88.0	40	80.0	
6 to 10	11	5	10.0	6	12.0	
>10	4	1	2.0	3	6.0	
Without data	1	0	0.0	1	2.0	
Oral sex						0.094
Yes	66	29	58.0	37	74.0	
No	34	21	42.0	13	26.0	
Anal sex						0.629
Yes	33	16	32.0	17	34.0	
No	67	34	68.0	33	66.0	
Pregnancies						0.597
0	19	12	24.0	7	14.0	
1 to 5	78	36	72.0	42	84.0	
6 to 10	3	2	4.0	1	2.0	
History of STIs						0.387
Yes	6	2	4.0	4	8.0	
No	94	48	96.0	46	92.0	
Oral lesion						0.753

Yes	2	1	2.0	1	2.0	
No	98	49	98.0	49	98.0	
Use of contraceptive method						0.234
Yes	69	31	62.0	38	76.0	
No	31	19	38.0	12	24.0	
Tobacco						0.283
Yes	20	7	14.0	13	26.0	
No	80	43	86.0	37	74.0	
C. trachomatis						**0.013**
Yes	49	19	38.0	30	60.0	
No	51	31	42.0	20	40.0	
HPV						**0.041**
Yes	27	18	36.0	9	18.0	
No	73	32	64.0	41	82.0	
Co-infection HPV- *C. trachomatis*						
Yes	14	7	14.0	7	14.0	1.000
No	86	43	86.0	43	86.0	

Table 2. Characteristics of 14 patients coinfected with HPV and *C. trachomatis.*

Cytology	Genital HPV	Oral HPV	HPV type	Genital *C. trachomatis*	Oral *C. trachomatis*
Abnormal-LSIL		✓	16	✓	✓
Abnormal-HSIL	✓		16 - 31	✓	✓
Abnormal-LSIL		✓	W/G		✓
Abnormal-LSIL	✓		W/G	✓	✓
Abnormal-LSIL		✓	W/G		✓
Abnormal-LSIL	✓		W/G	✓	
Abnormal-HSIL	✓	✓	16		✓
Normal	✓		W/G	✓	✓
Normal	✓		16 - 31	✓	
Normal	✓		W/G	✓	
Normal	✓		58	✓	
Normal		✓	16	✓	✓
Normal	✓	✓	16	✓	
Normal	✓		W/G		✓

HSIL: high-grade squamous intraepithelial lesion - **LSIL**: low-grade squamous intraepithelial lesion- **W/G**: without genotype.

Figures

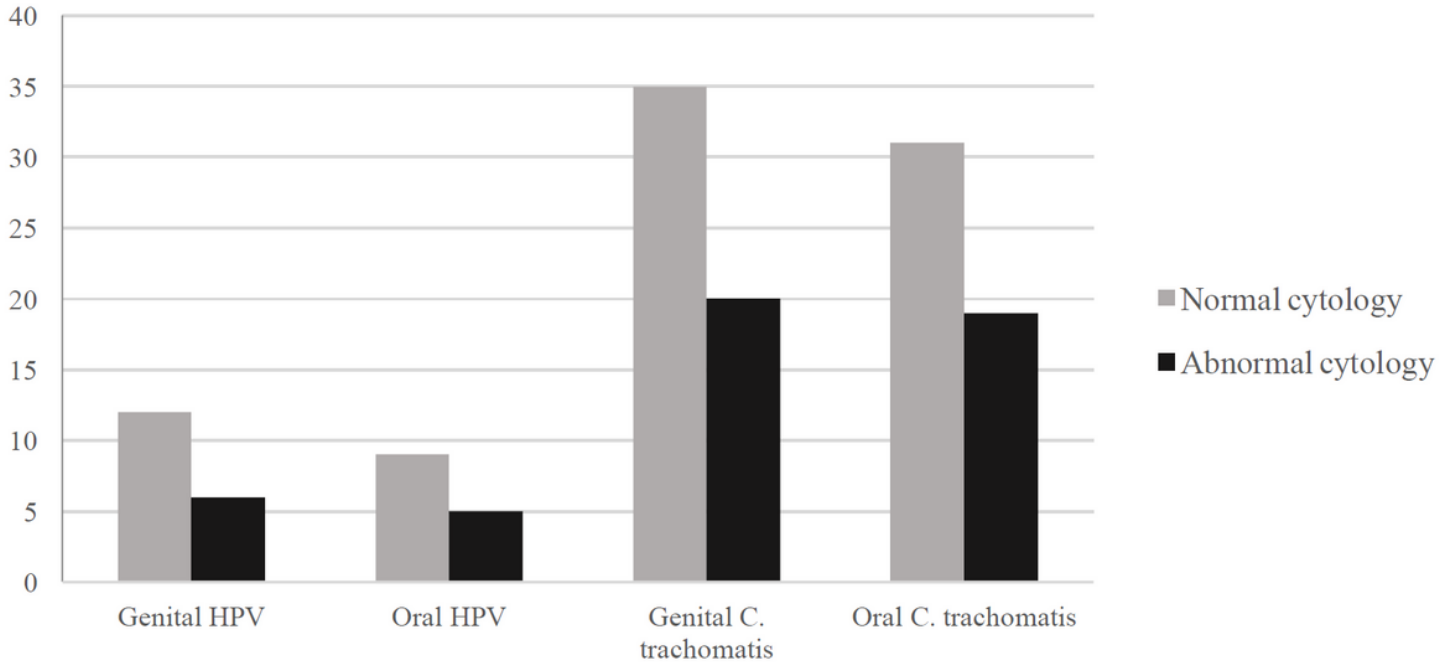

Figure 1

HPV and C. trachomatis distribution according cytology status in the both mucosas.

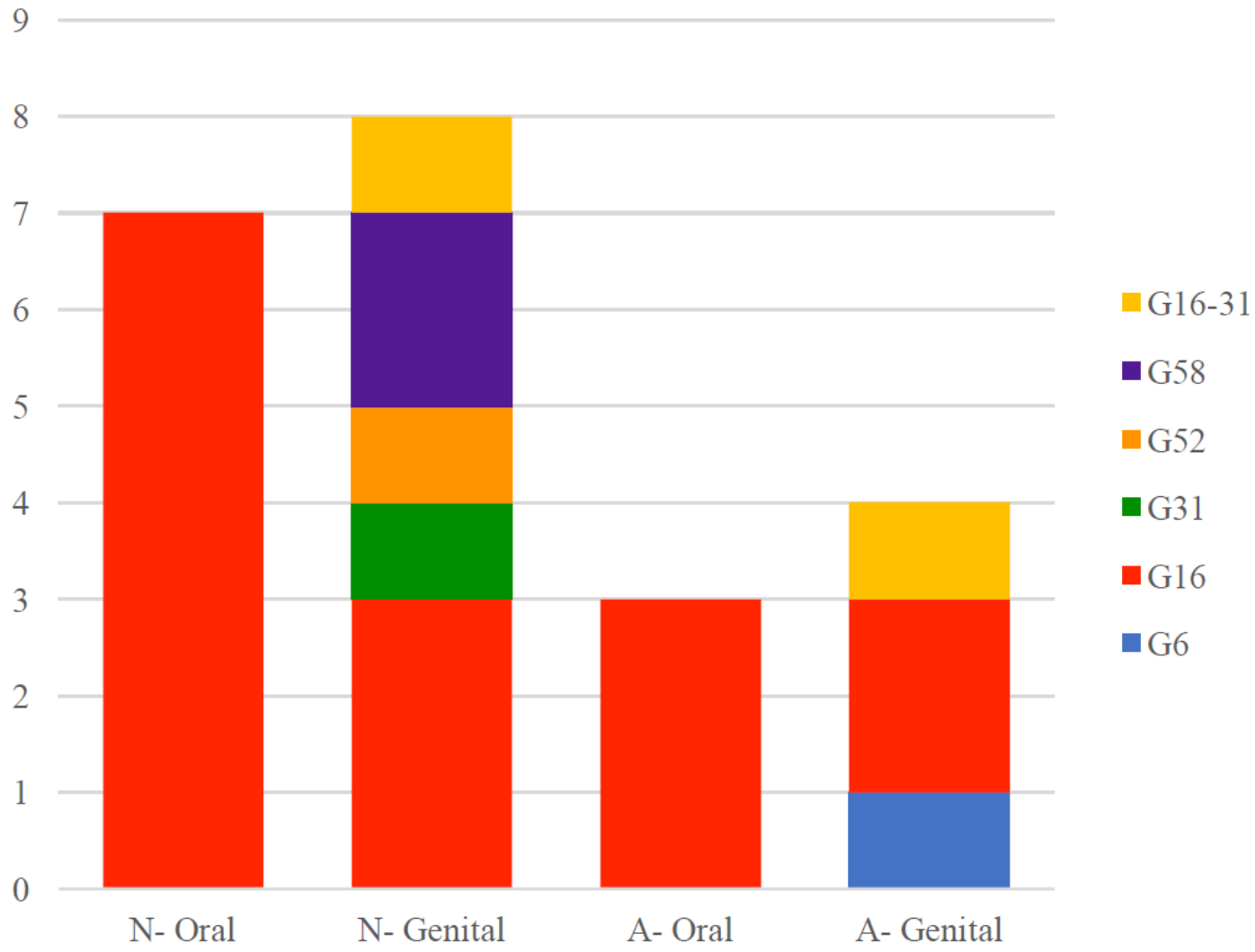

Figure 2

HPV genotypes detected according mucosa and cytology status. N-Oral: Normal cervical cytology- Oral mucosa- N-Genital: Normal cervical cytology- Genital Mucosa- A-Oral: Abnormal cervical cytology- Oral mucosa- A-Genital: Abnormal cervical cytology- Genital mucosa- G: Genotype.