Research Article ISSN: 2836-3647

American Journal of Pathology & Research

Association between Vaginal Discharge Features and Cervical Neoplastic Changes: Pap. Test Screened Sudanese Ladies

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Received: 18 Jun 2025; **Accepted:** 15 Jul 2025; **Published:** 29 Jul 2025

Citation: Ahmed Amin Mohammed Ahmed, Omar Hussein Darkhabani, Awad Eljeed Abogooda, et al. Association between Vaginal Discharge Features and Cervical Neoplastic Changes: Pap. Test Screened Sudanese Ladies. American J Pathol Res. 2025; 4(3): 1-5.

ABSTRACT

Background: *Cervical screening detects precancerous cells that may lead to cancer. Therefore, this study aimed to assess the correlation between cervical neoplastic changes and the features of vaginal discharge in Sudanese women who have undergone Pap screening.*

Methodology: *This prospective study was conducted in El-Obeid, North Kordofan State, during the period from May 2024 to May 2025. All participants (82 women) had presented to HighCare clinic in El-Obeid complaining of vaginal discharge.*

Results: *Most patients presented with whitish discharge (70.7%), followed by yellowish discharge (17%). Out of 58 patients with whitish discharge, 34.5% were identified with cytological atypia. Of the 20 patients with atypia, 65% had mild cytological atypia, 315% had moderate atypia, and 20% had severe cytological atypia. The association between whitish discharge and cytological atypia, the odd ratio (OR), and the 95% confidence interval (95%CI); OR (95%CI) = 1.3103 (0.5532 to 3.1037), p-value = 0.5390. Regarding odor, most patients presented with odorless discharge, 53.7% of whom were found to have cytological atypia (50% mild, 40% moderate, and 10% severe). About 46.3% of patients presented with offensive odor discharge, of whom 39.5% were detected with cytological atypia (66.7% mild, 7% moderate, and 27% severe). The association between offensive odor discharge and cytological atypia, OR (95% CI) = 1.7368 (0.6989 to 4.3162), p-value = 0.2346.*

Conclusion: *HPV is prevalent among Sudanese ladies at reproductive age, which is associated with increased epithelial dysplastic changes. Whitish offensive vaginal discharge might be associated with underlying cytological atypia.*

Keywords
Cervical cancer, Atypia, Pap. Test, Vaginal discharge, Sudan.

Introduction
Globally, cervical cancer is the fourth most frequent malignancy in women. Cervical cancer was the fourth leading cause of cancer deaths in women globally in 2022, with 662,044 cases (ASIR: 14.12/100,000) and 348,709 deaths (ASMR: 7.08/100,000). China (23% and 16%) and India (19% and 23%) had 42% of cases and 39% of deaths. HDI lowered ASIR and ASMR of cervical cancer, with equivalent effects on early-onset (0–39 years) and late-onset (≥40 years) cases. During 2003–2012, ASIR and ASMR of overall cervical cancer decreased (EAPC: 0.04% and -1.03%), but early-onset cervical cancer increased (1.16% and 0.57%). Cervical cancer cases and fatalities are expected to rise 56.8% and 80.7% by 2050 if 2022 rates remain steady. In transitioning countries, early-onset cervical cancer is likely to rise, while the burden is expected to decline [1,2].

The World Health Organization's effort to eliminate cervical cancer has led to significant treatment advances. Due to its well-established etiology, cervical cancer, mostly caused by HPV infection, is preventable and controllable. Precision screening technologies, including DNA methylation triage, HPV integration detection, liquid biopsies, and AI-assisted diagnostics, have improved HPV nucleic acid testing and cytology [3].

Cervical cancer poses a considerable health risk for women in Sudan, being the second most prevalent malignancy among them and a primary contributor to cancer-related mortality. The disease poses significant challenges due to late-stage diagnosis, which is ascribed to insufficient screening programs and restricted healthcare access [4].

Early detection and treatment can cure cervical cancer. Recognizing symptoms and seeking medical advice are crucial. Unusual bleeding between periods, after menopause, or after sexual activity; increased or foul-smelling vaginal discharge; persistent back, leg, or pelvic pain; weight loss, fatigue, and loss of appetite; vaginal discomfort; and leg swelling should be seen by a doctor.

Clinical examinations and testing to confirm a diagnosis are followed by referral for treatment, which may include surgery, radiation, chemotherapy, and palliative care for pain management and support.

Management pathways for invasive cancer care help patients get referred quickly and manage diagnosis and treatment options. Quality care involves a multidisciplinary team diagnosing and staging (histological testing, pathology, imaging) before treatment, following national guidelines, and providing holistic psychological, spiritual, physical, and palliative care.

Increased cervical screening in low- and middle-income nations will lead to a rise in invasive cervical cancer cases, particularly among unscreened populations. Referral and cancer management techniques must be increased with preventative services [5]. Therefore, the current study aimed to assess the correlation between cervical neoplastic alterations and vaginal discharge characteristics. Sudanese women have been screened by Pap.

Materials and Methods
This prospective study was conducted in El-Obeid, North Kordofan State, during the period from May 2024 to May 2025. All participants (82 women) had presented to the HighCare clinic in El-Obeid complaining of vaginal discharge. All respondents during the period of sample collection were selected regardless of age and other demographic characteristics. Pregnant ladies and those with clinically normal vaginal discharge were excluded.

Sample collection
Cervical cells are obtained utilizing a small brush or spatula. These devices are intended to collect cells from the transformation zone, which is the region most susceptible to changes, where the ectocervix and endocervix converge. The collected cells are subsequently smeared onto a glass slide and promptly fixed with a solution such as 95% ethyl alcohol.

Papanicolaou Staining Method
Ethyl alcohol-fixed smears were hydrated in a series of descending concentrations, transitioning from 95% alcohol to 70% alcohol and finally to distilled water, with each stage lasting two minutes. The smears were then soaked in Harris' hematoxylin for five minutes to color the nuclei, washed in distilled water, and briefly treated with 0.5% hydrochloric acid to remove any extra stain. The samples were subsequently rinsed in distilled water to halt the discoloration process. The smears were subsequently treated with alkaline water for a few seconds and dehydrated using ascending concentrations of alcohol, starting at 70% and progressing through two changes of 95% alcohol, with each change lasting two minutes. The smears were subsequently treated with Eosin Azure 50 for a duration of four minutes. Cytoplasmic staining included using Papanicolaou Orange G6 for two minutes, then rinsing with 95% alcohol and drying with pure alcohol. The smears were subsequently cleared in xylene and mounted in DPX (Distrene Polystyrene Xylene) medium [6].

Cytological Assessment
Atypia was evaluated cytologically according to the criteria outlined in previous studies [7]. The presence of two or more of the following features is indicative of atypia: nuclear enlargement with an increased nuclear-cytoplasmic ratio, hyperchromatism, chromatin clumping with moderately prominent nucleoli, irregular nuclear membranes, bi- or multinucleation, scant cytoplasm, and variation in the size and shape of cells and nuclei.

Statistical Analysis
Statistical analysis was conducted using SPSS version 24 software. The numeric results for cytological atypia and discharge were expressed as the 95% confidence intervals of the means. The

X^2 test was employed to analyze the differences in categorical variables across the groups. Variable relationships were examined through Pearson's correlation analysis. A p-value of less than 0.05 was deemed statistically significant.

Results

In this study, 82 women were screened, aged 20–55, with a mean age of 35 years old. The age variable was only available for 32 patients, of whom 16/32 (50%) were aged 31-35 years and 12/32 (37.6%) were aged 36-40 years. The distribution of the study population by demographic characteristics was summarized in Table 1, Fig. 1. Most patients were multiparous, 35/82 (42.7%), followed by nulliparous, 26/82 (31.7%). Most patients were housewives, 67/82 (81.7%), and most of them had a basic education level, 39/82 (47.6%).

Table 1: Distribution of the study population by demographic characteristics.

Variable	Rural n=43	Urban n=39	Total n=82
Marital Status			
Married	43	37	80
Divorced	0	2	2
Parity			
Nulliparous	18	8	26
Primigravid	1	0	1
Para1	5	8	13
Multiparous	16	19	35
Grandmultipara	3	4	7
Occupation			
Housewife	36	31	67
Teacher	2	4	6
Employer	1	0	1
Farmer	2	0	2
Medical	2	4	6
Education			
Illiterate	4	4	8
Basic	26	13	39
Secondary	8	12	20
Diploma	2	0	2
University	3	9	12
Postgraduate	0	1	1
Age			
20-30 years	1	2	3
31-35 years	7	9	16
36-40 years	8	4	12
<40 years	0	1	1

Cytological atypia was observed in 25/82 (30.5%) women, including 15/25 (60%) with mild atypia, 5/25 (20%) with moderate atypia, and 5/25 (20%) with severe atypia. Cytological signs of HPV infection (koilocytosis) were found in 14 out of 82 cases (17%), with 7 of those having moderate atypia and 5 having mild atypia. Candida albicans was seen in 8/82 (9.8%) cases, comprising 6/8 (75%) mild atypia and 2/8 (25%) moderate atypia, as indicated in Table 2, Figure 2.

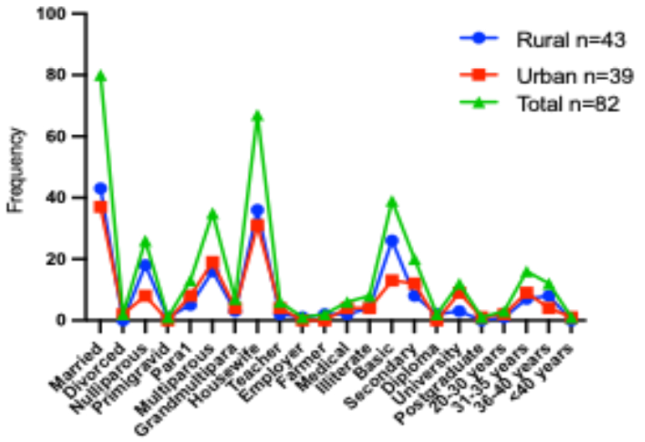

Figure 1: Description of the study population by demographic characteristics.

Table 2: Distribution of the study population by cellular proliferative activity and HPV and Candida albicans.

Variable	Normal	Mild Atypia	Moderate atypia	Severe atypia	Total
Indication of HPV (Koilocytosis)					
None	52	8	4	4	68
HPV	5	7	1	1	14
Total	57	15	5	5	82
Candida Albicans					
No	51	13	5	5	74
Yes	6	2	0	0	8
Total	57	15	5	5	82

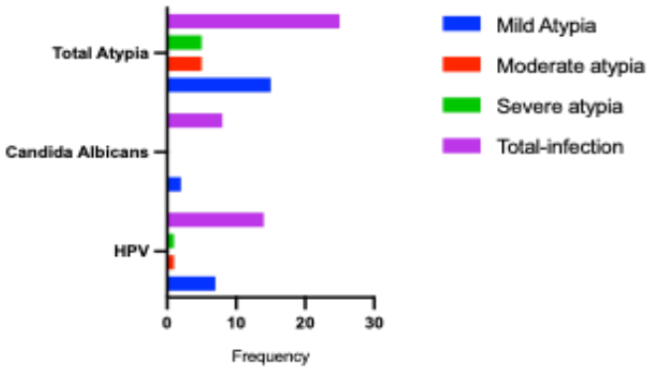

Figure 2: Illustrates the cellular proliferative activity associated with HPV and Candida albicans.

Table 3, Figure 3, summarized the distribution of the cytological atypia by discharge color, odor, and presence of itching. Most patients presented with whitish discharge, 58/82 (70.7%), followed by yellowish discharge, 14/82 (17%). Out of 58 patients with whitish discharge, 20/58 (34.5%) were identified with cytological atypia. Of the 20 patients with atypia, 13/20 (65%) had mild cytological atypia, 3/20 (15%) had moderate atypia, and 4/20 (20%) had severe cytological atypia. The association between whitish discharge and cytological atypia, the odd ratio (OR), and the 95% confidence interval (95%CI); OR (95%CI) = 1.3103 (0.5532 to 3.1037), p-value = 0.5390.

Regarding odor, most patients presented with odorless discharge, 44/82 (53.7%), of whom 10/44 (22.7%) were found with cytological atypia (5/10 (50%) mild, 4/10 (40%) moderate, and 1/10 (10%) severe). About 38 out of 82 patients (46.3%) had discharge with a bad smell, and among them, 15 out of 38 (39.5%) showed signs of cytological atypia (10 out of 15, or 66.7%, had mild atypia, 1 out of 15, or 7%, had moderate, and 4 out of 15, or 27%, had severe). The association between offensive odor discharge and cytological atypia, OR (95% CI) = 1.7368 (0.6989 to 4.3162), p-value = 0.2346.

Itching was experienced in 47/82 (57.3%) patients, of whom 16/47 (34%) were detected with cytological atypia (11/16 (68.8%) mild atypia, 3/16 (18.8%) moderate, and 2/16 (12.3%) severe). The association between itching and cytological atypia, OR (95% CI) = 1.4141 (0.5582 to 3.5824), p-value = 0.4650, as indicated in Table 3, Figure 3.

Table 3: Distribution of the cellular proliferative activity by discharge color, odor, and presence of itching.

Variable	Normal Smear	Mild Atypia	Moderate atypia	Severe atypia	Total
Discharge Color					
Whitish	38	13	3	4	58
Yellowish	10	2	1	1	14
Greenish	2	0	0	0	2
Brownish	4	0	1	0	5
Other	3	0	0	0	3
Total	57	15	5	5	82
Discharge odor					
Odorless	34	5	4	1	44
Offensive odor	23	10	1	4	38
Total	57	15	5	5	82
Itching					
No	26	4	2	3	35
Yes	31	11	3	2	47
Total	57	15	5	5	82

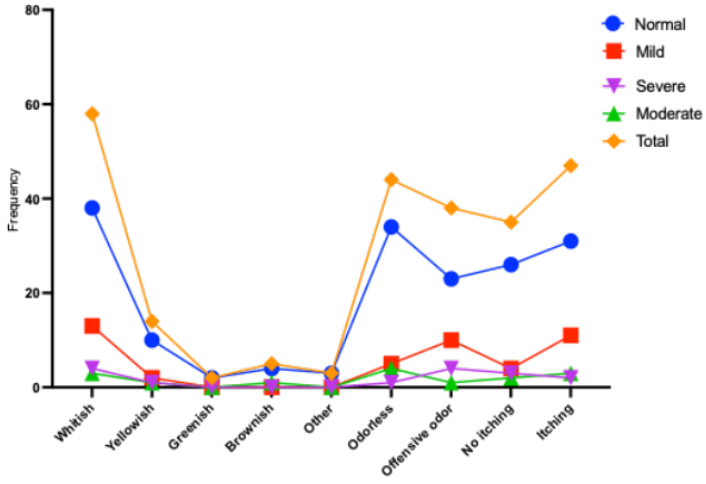

Figure 3: Description of the cellular proliferative activity by discharge color, odor, and presence of itching.

Discussion

Cervical cancer is a significant yet often overlooked health issue in Sudan. This is attributable to the lack of preventive measures (absence of HPV vaccination) and the absence of a sustained cervical screening program in the country. The current study's findings indicate elevated levels of cervical cellular proliferation, along with a heightened incidence of HPV infection. Cervical cancer, induced by oncogenic strains of human papillomavirus (HPV), is a predominant preventable contributor to cancer-related morbidity and mortality worldwide. Chronic, persistent HPV infections that lead to cervical precursor lesions, if discovered and untreated, may advance to invasive cancer. Cervical cancer screening technologies have progressed from cytology (Papanicolaou test) to extremely sensitive HPV-based molecular techniques and tailored, risk-stratified care protocols. Innovations such as self-sample collection to improve screening accessibility, advanced triage techniques to optimize the management of positive screenings, and scalable, effective precancer treatment strategies will be essential to augment the efficacy of preventive interventions [8]. The most recent WHO guidelines on vaccinations are outlined, along with notifications of forthcoming changes. The concluding section of the article outlines innovative diagnostic and treatment approaches, alongside insights and recent research developments regarding self-administered diagnostic tests, therapeutic vaccines, and the application of circulating cell-free DNA in diagnosis. Despite substantial advancements in recent years, the strategy centered on vaccination and testing continues to be fundamental in combating HPV-related cervical cancer [9].

The findings of this study indicate that the majority of patients presented with a whitish, offensive vaginal discharge. Initial manifestations of cervical cancer, including vaginal bleeding or discharge, frequently resemble typical alterations during pregnancy, which may result in diagnostic delays. Cervical dysplasia, recognized as a precursor to cervical cancer, is significantly linked to high-risk HPV infection, impacting around 25% of women of reproductive age. Cytology and HPV testing for screening during pregnancy are deemed safe and effective for early detection [10].

Increased, watery, bloody, or foul-smelling vaginal discharge may indicate cervical cancer. Normal vaginal discharge can vary; however, alterations in color, consistency, or odor, particularly when associated with additional symptoms such as intermenstrual bleeding or postcoital bleeding, warrant medical evaluation [11]. Nevertheless, the literature concerning the relationship between the characteristics of vaginal discharge and the underlying presence of cellular proliferative activity is quite limited.

The current study offers an update on the cervical burden in Sudan; however, it is limited by a small sample size and the absence of confirmatory molecular testing for positive cases.

Conclusion

In conclusion, human papillomavirus (HPV) is common among Sudanese women of reproductive age, correlating with

heightened epithelial dysplastic alterations. Whitish, offensive vaginal discharge may be linked to underlying cytological atypia. Immediate actions are necessary to prevent patients from presenting with advanced stages of the disease. Implementing a national cervical screening program, in conjunction with the introduction of the HPV vaccine, is essential in Sudan.

The authors express their gratitude to the authorities at High-Care clinic for granting permission to carry out this study.

Funding

The Prof. Medical Research Consultancy Center (PMRCC) funded this project. Grant Number: PMRCC/2025A12.

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