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Lifestyle Risk Factors Associated with Cervical Precancerous Lesions

Luvi Dian Afriyani[1]*, Erlin Saafatilah[2], Partini[3]
[1-3]Universitas Ngudi Waluyo, Indonesia
***Corresponding Author:** luviqanaiz@gmail.com

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ABSTRACT

Introduction:. Cervical cancer is one of the leading causes of death among women, particularly in developing countries such as Indonesia. In Indonesia, cervical cancer is the second most prevalent cancer among women, after breast cancer. Cervical cancer generally progresses in a gradual manner, beginning with a persistent infection by high-risk types of Human Papilloma virus (HPV), which can develop into precancerous lesions and, over time, advance to invasive cervical cancer. The progression of these precancerous lesions may be influenced by unhealthy lifestyle factors .
Objective: This study aims to examine lifestyle-related risk factors, such as exposure to tobacco smoke, intake of processed or preserved foods, and low levels of physical activity.
Methods: This study employed a correlational analytic design with a cross-sectional approach. The sample consisted of 123 women of reproductive age who underwent IVA (Inspeksi Visual Aids) screening from January to June 2025. Data were collected through anamnesis and IVA test results at Puskesmas Candiroto, Temanggung Regency.
Results: The results showed that exposure to cigarette smoke was significantly associated with cervical precancerous lesions (p-value = 0.000 < α = 0.05), while consumption of preserved foods (p-value = 0.1 > α = 0.05) and lack of physical activity (p-value = 0.1 > α = 0.05) were not significantly associated.
Conclusions : The conclusion of this study is that exposure to cigarettes poses a risk for cervical precancerous lesions, as indicated by positive results on cervical examination using acetic acid.

Keywords: cervical precancerous lesions, lifestyle, risk factors

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INTRODUCTION

Cancer is one of the leading causes of morbidity and mortality worldwide, with incidence and death rates continuing to increase each year. Cervical cancer is among the major types of cancer responsible for significant mortality among women globally. According to global cancer statistics reported by GLOBOCAN (2020), there were approximately 604,000 new cases and 342,000 deaths due to cervical cancer in 2020. (Sung et al., 2021). Based on GLOBOCAN (2022) data, cervical cancer ranked eighth among all cancer types; however, the number of new cases increased compared to 2020, reaching 661,021 new cases and 348,189 deaths. (Bray et al., 2024). The incidence of cervical cancer in Indonesia remains high. According to GLOBOCAN (2022), cervical cancer ranks second among all cancer types affecting women in Indonesia. There were 36,964 new cases and 20,708 deaths reported. (Ferlay et al., 2021). The high mortality rate associated with cervical cancer is largely attributed to delayed diagnosis and treatment, as nearly 70% of patients are diagnosed at an advanced stage. Early detection of cervical abnormalities at the precancerous stage allows for effective treatment, thereby preventing progression to invasive cancer (Kementrian Kesehatan RI, 2024).

Cervical cancer is caused by infection with oncogenic subtypes of the Human Papillomavirus (HPV), particularly subtypes 16 and 18. The development of invasive cancer begins with neoplastic lesions in the cervical epithelial layer, progressing from Cervical Intraepithelial Neoplasia (CIN) 1, CIN 2, CIN 3, to carcinoma in situ (CIS). Once the lesion penetrates the basement membrane, it may advance to microinvasive and subsequently invasive carcinoma. Generally, precancerous lesions are asymptomatic; however, once invasive cancer develops, the most common symptoms include abnormal bleeding (such as contact bleeding or postcoital bleeding) and vaginal discharge.(Kementrian Kesehatan RI, 2019)

Following HPV infection, normal cervical cells may undergo transformation into abnormal cells or develop into precancerous cervical lesions. The progression of these precancerous lesions is influenced by several predisposing factors, among which lifestyle factors play a significant role. Smoking is a major lifestyle-related risk factor, as it can double the likelihood of persistent HPV infection and accelerate carcinogenesis; even passive smoking has been reported to increase the risk by up to 20% (Farina et al., 2025). Cervical cancer is primarily caused by persistent infection with high-risk HPV types, and smoking exacerbates viral persistence and promotes oncogenic progression.

A review conducted by Yulia Armenda and Helda (2023) reported that exposure to tobacco smoke either through active or passive smoking increases the risk of developing precancerous lesions, including both low-grade (CIN1/LSIL) and high-grade (CIN2/CIN3/HSIL) lesions, which may further progress to invasive cervical cancer. The biological mechanism underlying this association involves the immunosuppressive effects of chemical compounds present in tobacco smoke, which promote HPV persistence and progression to precancerous lesions. Moreover, the carcinogenic substances in tobacco can induce DNA damage in cervical epithelial cells, thereby increasing the risk of invasive cervical cancer (Armenda & Helda, 2023)

Insufficient physical activity has also been identified as a risk factor for HPV infection. Several studies have demonstrated an association between physical activity levels and the risk of cervical cancer, indicating that lower duration or intensity of physical activity is linked to a higher risk of cervical cancer(Xing et al., 2022) . Another study reported that participants engaging in ≥3.75 MET-hours per week of physical activity had a significantly lower risk of cervical intraepithelial neoplasia (CIN) compared with those performing <3.75 MET-hours per week (p = 0.01). However, among HPV-infected or smoking participants, the minimum level of leisure-time physical activity required to reduce CIN risk was ≥7.5 MET-hours per week. Therefore, it is recommended that women engage in regular light-to-moderate physical activity each week, with

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an energy expenditure of at least 7.5 MET-hours per week, to help reduce the risk of cervical neoplasia (Chang et al., 2020).

The contribution of dietary patterns to cancer risk is considered to be greater in developed countries than in developing ones. In cervical cancer, the most significant role of diet and nutrition relates to prevention and the management of Human Papillomavirus (HPV) infection. The primary protective dietary factors that may reduce the risk of cervical cancer are antioxidants, including vitamins A, C, D, and E, as well as carotenoids, vegetables, and fruits. These antioxidants may exert varying effects on the natural course of HPV-related disease progression.

The objective of this study is to analyze lifestyle factors associated with cervical cancer risk, specifically tobacco smoke exposure, physical activity, and consumption of preserved foods.

MATERIALS AND METHODS

This study employed a correlational analytic design with a cross-sectional approach. The population consisted of all women of reproductive age (WRA) residing in the working area of Candiroto Public Health Center, Temanggung. The sample included 123 women of reproductive age who underwent Visual Inspection with Acetic Acid (VIA) testing between January and June 2025. The sampling technique used was accidental sampling. This research has passed ethical review with document number 408/KEP/EC/UNW/2025 from the Ethics Committee of Ngudi Waluyo University. Data were obtained from medical records, including anamnesis documentation and IVA test results from the Candiroto Public Health Center, Temanggung District. Data were analyzed using the Chi-square test.

RESULTS

This study involved 123 women of reproductive age, who underwent Visual Inspection with Acetic Acid (VIA) testing at the Candiroto Public Health Center, Temanggung. The following section presents an overview of the research findings.

1. Overview of Risk Factors and the Occurrence of Precancerous Lesions

Table 1. Exposure to Cigarette Smoke Among Respondents

Exposure to Cigarette Smoke	Frequency (n)	Percentage(%)
Exposed	71	57,7%
Not exposed	52	42,3%
Total	123	100

The results show that most respondents (57.7%) were exposed to cigarette smoke, either as active smokers or passive smokers

Table 2. Description of Physical Activity Among Respondents

Physical Activity	Frekuensi (n)	Percentage(%)
< 30 minutes/day	80	65,04 %
≥ 30 minutes/day	43	34,96 %
Jumlah	123	100%

The results indicate that most respondents (65.04%) engaged in physical activity for less than 30 minutes per day

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Table 3. Consumption of Preserved Foods Among Respondents

Preserved Food Consumption	Frekuensi (n)	Percentage (%)
Consumed	119	97 %
Not consumed	4	3 %
Jumlah	123	100%

The results indicate that almost all respondents (97%) consumed preserved foods.

Table 4. Occurrence of Precancerous Lesions

Precancerous Lesion	Frekuensi (n)	Percentage (%)
Positif	52	42,3%
Negatif	71	57,7%
Jumlah	123	100%

The results indicate that the majority of respondents (57.7%) tested negative for precancerous lesions**.**

2. Lifestyle Risk Factors for Cervical Precancerous Lesions

Table 5. Association Between Exposure to Cigarette Smoke and Cervical Precancerous Lesions

Exposure to Cigarette Smoke	Precancerous Lesion				Total		*p-value*
	Negatif		Positif				
	F	%	F	%	F	%	
Exposed	21	17,7	50	40,7	71	57,7	0,000
Not exposed	50	40,7	2	1,6	52	42,3	
Jumlah	71	57,7	52	42,3	123	100	

The results indicate that respondents exposed to cigarette smoke were more likely to have a positive IVA test, indicating precancerous lesions (40.7%) compared to negative results (17.7%). In contrast, respondents not exposed to cigarette smoke were more likely to have a negative (40.7%) than a positive one (1.6%). These findings suggest that exposure to cigarette smoke may increase the risk of developing precancerous lesions detectable through IVA testing. Statistical analysis using the Chi-square test yielded a p-value of 0.000 ($p < 0.05$), indicating that H_0 is rejected. Therefore, there is a significant association between exposure to cigarette smoke and IVA test results in the working area of Candiroto Public Health Center, Temanggung District.

Table 6. Association Between Physical Activity and Cervical Precancerous

Physical Activity	Precancerous Lesion				Total		*p-value*
	Negatif		Positif				
	F	%	F	%	F	%	
≥ 30 minutes/day	29	23,58	29	23,58	58	47,16	0,1
< 30 minutes/day	43	34,95	23	18,69	66	53,64	
Jumlah	71	57,7	52	42,3	123	100	

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The results indicate that physical activity for 30 minutes or more per day showed precancerous lesions in 23.58% of cases, while those without precancerous lesions had the same percentage (23.58%). Respondents who performed less than 30 minutes of physical activity per day were more likely to have no lesions (34.95%), while 18.69% showed the presence of precancerous lesions. Statistical analysis using the Chi-square test yielded a p-value of 0.1(p >0.05). The results of the study indicate that there is no relationship between physical activity and precancerous lesions

Table 7. Association Between Consumption of Preserved Foods and Cervical Precancerous

Consumption of Preserved Foods	Precancerous Lesion				Total		*p-value*
	Negatif		Positif				
	F	%	F	%	F	%	
No	14	11,38	8	6,50	22	17,88	0,1
Yes	57	46,34	44	35,78	101	82,12	
Jumlah	71	57,7	52	42,3	123	100	

The results of the study show that respondents who consumed preserved foods and did not have precancerous lesions accounted for 46.34%, while those with precancerous lesions accounted for 35.78%. Among respondents who did not consume preserved foods, 11.38% showed negative results (no lesions) and 6.50% showed positive results (presence of precancerous lesions). Statistical analysis using the Chi-square test yielded a p-value of 0.1(p >0.05). These results indicate that there is no relationship between physical activity and precancerous lesions

DISCUSSION

Research has demonstrated a significant association between cigarette smoke exposure and the development of precancerous lesions, as evidenced by positive findings in the visual inspection with acetic acid (IVA test). Several studies have indicated that carcinogenic compounds in cigarette smoke can induce DNA damage in cervical epithelial cells, particularly among female smokers, thereby increasing the potential for malignant transformation. Moreover, smoking can suppress local immune defenses—such as Langerhans cells in the cervical epithelium—which play a crucial role in combating HPV infection and eliminating abnormal cells. A study by Luyang Su et al. (2025) reported that, based on observational analysis, active smokers exhibited a significantly higher risk of cervical cancer compared to non-smokers and former smokers (adjusted odds ratio = 3.05; 95% confidence interval: 1.61–5.78; p < 0.001). In addition, higher serum cotinine levels were positively correlated with an increased risk of cervical cancer (Su et al., 2025).

Further research has established that high-risk HPV (HR-HPV) infection is the primary cause of cervical cancer; however, infection alone is insufficient to induce malignant transformation. Exposure to cigarette smoke acts as a cofactor that elevates risk, as women who smoke are more susceptible to cervical cancer, and a subset of HPV-positive head and neck cancer patients are also smokers. Cigarette smoking enhances the expression of HPV oncogenic proteins (E6 and E7), induces DNA damage in epithelial cells, and suppresses immune function, thereby facilitating the persistence and progression of HPV infection. Preventive and therapeutic strategies—including smoking cessation, avoidance of smoke exposure, HPV vaccination, and the development of novel therapies for cervical cancer—are therefore recommended (Aguayo et al., 2020).

Research has shown that physical activity is not associated with precancerous lesions, as indicated by positive results in the visual inspection with acetic acid test. In this study, physical activity was defined as engaging in at least 30 minutes of activity per day. Regular physical activity can enhance immune system function. Optimal immunity plays a crucial role in combating Human

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Papillomavirus (HPV) infection, which is the primary cause of cervical cancer. Women who engage in sufficient physical activity demonstrate increased levels of T cells, natural killer (NK) cells, and specific antibodies, which help eliminate HPV-infected cells before they progress to precancerous lesions or cancer.

Although some studies suggest that physical activity may reduce the risk of cervical neoplasia, a recent meta-analysis indicates that studies examining the relationship between physical activity and cervical cancer are still very limited, with only two studies identified and nonsignificant results (RR = 1.06; 95% CI: 0.90–1.25 for moderate vs. low activity; RR = 0.77; 95% CI: 0.50–1.18 for high vs. low activity) (Cao et al., 2025). One study reported that physical activity had no effect on CIN 1 but was inversely associated with CIN 2/3 and cervical cancer, suggesting that physical activity may help prevent the progression of more severe lesions(Lee et al., 2013).Further studies are warranted to more thoroughly analyze the relationship between physical activity and precancerous lesions.

The study results indicate that there is no association between the consumption of preserved foods and the occurrence of precancerous lesions. The study found that the majority of respondents consumed preserved foods. Cervical cancer is primarily caused by Human Papillomavirus (HPV) infection; however, other factors, including nutrition and dietary patterns, may influence the risk of developing this cancer. Some studies suggest that diet and nutrition can affect the immune system and the body's ability to combat HPV infection, which may otherwise progress to cancerous cells. Research on the specific impact of preserved foods on the incidence of precancerous lesions remains limited. One study reported no association between the consumption of fatty and preserved foods and cervical cancer detection results using acetic acid inspection (Zuhana et al., 2019)

CONCLUSIONS

The results of this study indicate that cigarette smoke exposure is associated with precancerous lesions, as evidenced by positive findings in cervical visual inspection with acetic acid. In contrast, no associations were found between physical activity and the consumption of preserved foods with precancerous lesions. Smoking cessation and avoidance of cigarette smoke exposure are therefore important for the prevention of cervical cancer. Further research is needed to investigate the relationship between physical activity, consumption of preserved foods, and the development of precancerous lesions.

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Availability of data and materials

This study was conducted on a single group of women of reproductive age. Future research can be carried out using a case-control design with two groups to examine the independent variables, namely physical activity and the consumption of preserved foods

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Authors' contributions

This study was conducted by three researchers. The head researcher is Luvi Dian Afriyani, was responsible for preparing the research proposal, processing the data, compiling the research report, and writing the article. The two team members, Partini and Erlin Safaatilah, were responsible for collecting the data and preparing the research report.

Conflict of Interest

This study does not use commercial products

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