The Strength of Association between Smoking and Mortality from Cervical Cancer in Adult Women

By: Sydnie Morgan

1. INTRODUCTION

1.1 Definition and Symptoms of Cervical Cancer

Cervical cancer has been a formidable disease afflicting U.S. women for decades. It is defined as an abnormal growth of cells that originates in the cervix. These cells multiply quickly and continue living when they should naturally die during the cell cycle. The cells can then invade and destroy nearby healthy tissues (Mayo Clinic, 2023). Symptoms are particularly difficult to pinpoint due to early-stage cervical cancer rarely expressing any signs or symptoms. However, some early-stage cervical cancer symptoms can include pelvic pain and abnormal bleeding or discharge. This may manifest as watery, odorous discharge; vaginal bleeding after intercourse; having longer/heavier periods than normal; or vaginal bleeding after menopause. Common symptoms of advanced cervical cancer include painful/bloody urination, abdominal pain, swelling of the legs, feeling tired, and painful bowel movements accompanied by rectal bleeding (National Cancer Institute, 2022).

1.2 Mortality Rates of Cervical Cancer by Person, Place, and Time

In 2022, the crude death rate due to cervical cancer in Florida was 3.2 per 100,000. The age-adjusted death rate in 2022, due to cervical cancer in Florida was 2.6 per 100,000 with the population being derived from the Year 2000 Standard Population Proportion (Florida Department of Health, 2023). A geographical analysis comparing mortality rates by county, portrayed that counties in the central and northeast portions of the state, generally had higher mortality rates as compared to the rest of Florida. However, a cluster in the northwest portion of the state also had significantly high cervical cancer mortality rates as demonstrated by Figure 1

(Florida Department of Health, 2023). Environmental factors or community characteristics can possibly contribute to varying mortality rates throughout the state.

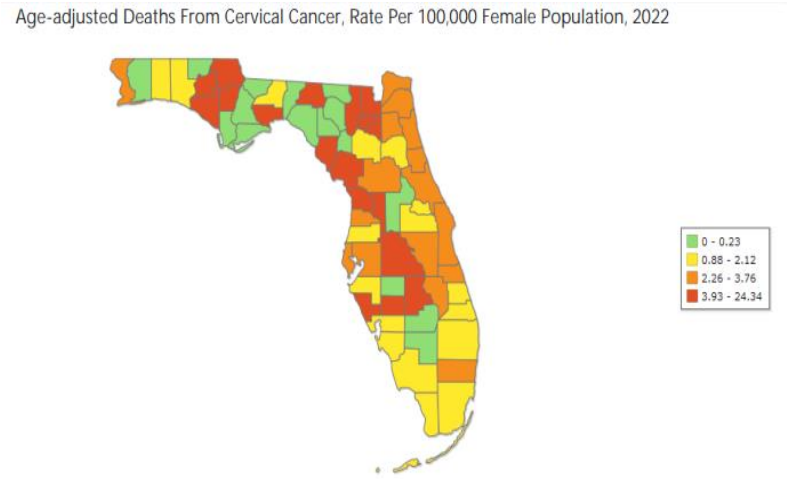

Figure 1: Comparison of age-adjusted mortality rates per 100,000 men by Florida Counties in 2022 (Florida Department of Health, 2023).

A comparison among ethnic groups demonstrated a stark disparity in relation to comorbidities leading to mortality rates due to murder, depression, poverty rates, and suicide between African American and White Florida men. Data retrieved from Florida Health CHARTS expressed that in 2022, White men had an age-adjusted mortality rate of 8,046 per 100,000; while African American men had an age-adjusted mortality rate of 9,935 per 100,000; a nearly 20 percent increase as shown in Figure 2 (Florida Department of Health, 2023). Discrepancies could be due to factors such as socioeconomic status or genetic predisposition.

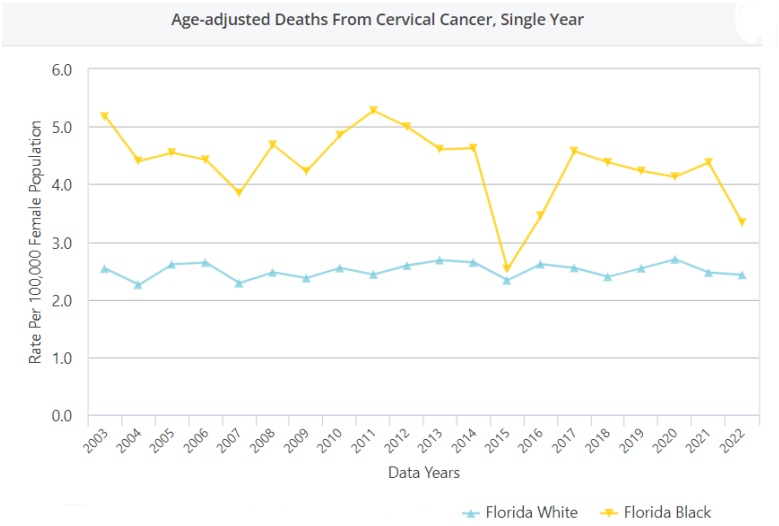

Figure 2: Comparison of age-adjusted cervical cancer mortality rates between black and white adult Floridian women (Florida Department of Health, 2023).

Throughout the last two decades, cervical cancer mortality rates have been relatively steady with rates staying between 2.3 and 2.9 per 100,000. However, there was a sharp decrease in the mortality rate in 2015 as compared to the year prior. In 2014, the mortality rate was 2.8, whereas in 2015, the mortality rate was 2.3, which is illustrated in Figure 3 (Florida Department of Health, 2023).

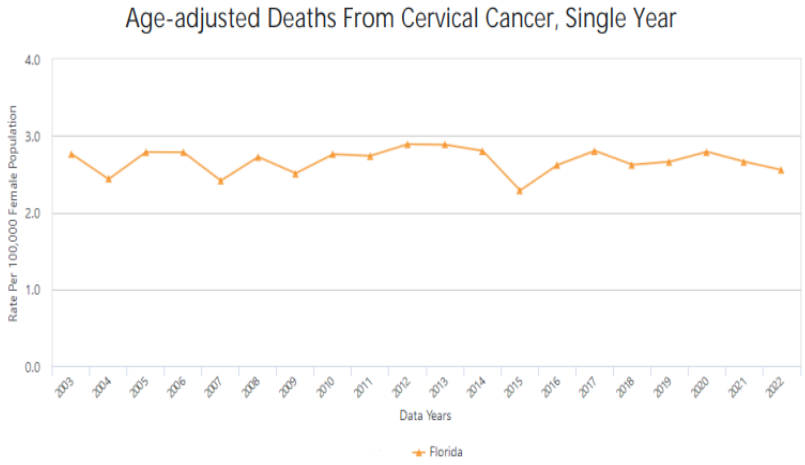

Figure 3: Changes in age-adjusted cervical cancer mortality rates over time in Florida (Florida Department of Health, 2023).

1.3 General Background of Smoking as a Risk Factor for Cervical Cancer

There are multiple factors that can contribute to the development of cervical cancer. Non-modifiable risk factors consist of familial history, race/ethnicity, diethylstilbestrol (a synthetic form of estrogen) exposure, and age (American Cancer Society, 2020). Contrarily, modifiable risk factors consist of sexual history, obesity, a weakened immune system, smoking, sexually transmitted infections (e.g., HPV), long-term oral contraceptive use, multiple pregnancies, and low consumption of fruits and vegetables (National Cancer Institute, 2023). This research paper

will concentrate on smoking, among these known risk factors. Tobacco smoke is considered a preeminent risk factor for cervical cancer development due to traces of tobacco by-product being found in the cervical mucous of women who smoke. Researchers believe that these by-products cause damage to the DNA of cervix cells and make the immune system less effective in fighting off HPV infections (American Cancer Society, 2020). Continued smoking after a cervical cancer diagnosis may lead to a lowered survival rate, however the strength of association between these two factors is still ambiguous.

1.4 Research Question

This study aims to examine the strength of the association between smoking and cervical cancer mortality among adult females using data from the FLHealthCHARTS.gov website and three published abstracts. For the correlation analysis, we will use age-adjusted mortality rates from cervical cancer and prevalence of smoking (adults who are currently smokers) for 67 Florida counties.

2. Methods

2.1 Correlation Analysis

In order to test a hypothesis regarding smoking prevalence and cervical cancer mortality, a correlation coefficient (r) was determined using a pre-programmed Excel spreadsheet provided by Dr. Lee for this course. Correlation coefficients are used to assess the strength and direction of the linear relationships between variables. It represents the slope of the linear regression line. The data for smoking prevalence and cervical cancer mortality in the year 2019 for 67 Florida counties was provided by FLHealthCHARTS.gov, from the Florida Department of Health, Division of Public Health Statistics and Performance Management. In general, an r value greater

than 0.7 is considered a strong correlation. A value between 0.5 and 0.7 is considered a moderate correlation. A value between 0.3 and 0.5 is a weak correlation. Anything less than 0.3 is considered no correlation. Additionally, a p-value is used to determine statistical significance. If a p-value is less than 0.05, it is considered statistically significant. Contrastingly, if a p-value is greater than 0.05, it is interpreted as the correlation not being significant or that there is no correlation.

2.2 Literature Review

In order to discover relevant articles relating the association between tobacco smoke and cervical cancer mortality, multiple research databases were employed. PubMed, Google Scholar, and JSTOR databases were accessed on February 29, 2024, using the keywords of cervical cancer, smoking, mortality, and deaths. The search was restricted to peer-reviewed journals within a 20-year time span between the years of 2004 and 2024 and original research articles on analytical epidemiologic studies. Three research abstracts were selected, and pertinent information was extracted. Such information consisted of the author, year of publication, title, DOI, study design, exposure variable, outcome variable, study sample (n), source population, target population, and the measure of association (OR/RR/HR) with a confidence interval of 95 percent.

3. Results

3.1 Correlation Between Smoking and Cervical Cancer Mortality in Florida from An Ecological Study

From the previously mentioned modifiable risk factors, smoking was chosen for further evaluation of potential correlation with cervical cancer mortality rates in Florida. The risk factor

was evaluated using the pre-programmed Excel spreadsheet. The specific data used was "Adults Who Are Current Smokers" provided by the Behavioral Risk Factor Surveillance System (BRFSS) from FLHealthCHARTS.gov. This was compared to cervical cancer mortality rates in Florida. Figure 4 depicts a correlation coefficient (r) of 0.303 and a p-value of 0.013. This indicates that there is a weak, but statistically significant positive correlation between smoking prevalence and cervical cancer mortality rates in Florida counties.

Slope	m=	0.249
Intercept	b=	-1.327
Correlation coefficient	**r=**	**0.303**
R-squared	r^2=	0.092
Sample size	N=	67
T-statistics	t-	2.563
	p-value=	**0.013**

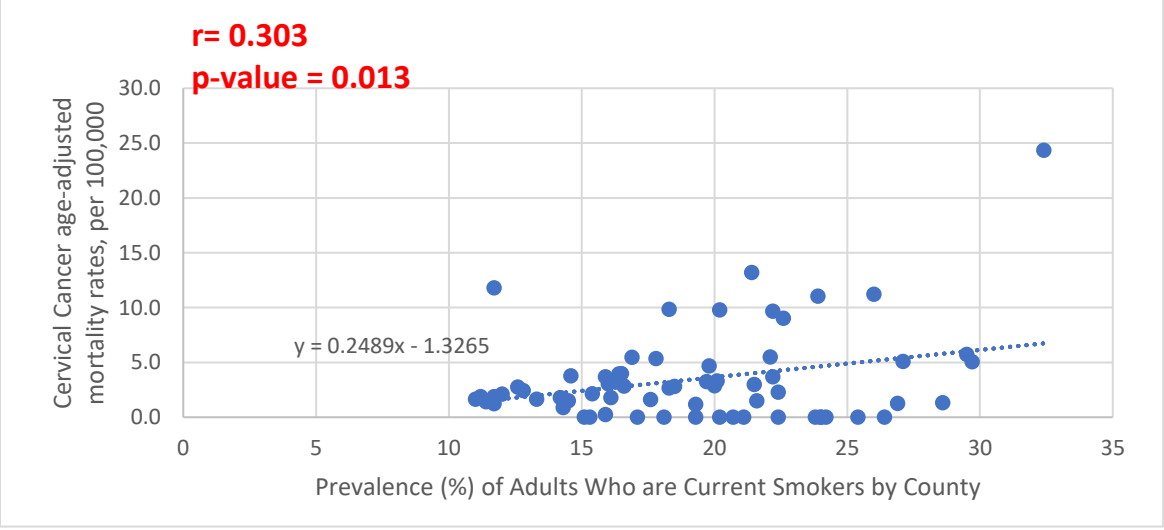

Figure 4: Correlation analysis between prevalence of adults who are current smokers and cervical cancer mortality rates.

3.2 Association Between Smoking and Cervical Cancer Mortality from Analytical Epidemiologic Studies

Table 1. Summary table with key information from 3 advanced analytical epidemiological studies

Abstract 1	
First author, year	Odongua, 2007
Title	Associations between smoking, screening, and death caused by cervical cancer in Korean women
DOI	10.3349/ymj.2007.48.2.192
Study design	Prospective cohort study
Exposure variable	Cigarette smoking
Outcome variable	Risk of incidence and mortality from cervical cancer
Study sample (n)	475,398 Korean women
Source population	Women aged 30 to 95 years who received health insurance from the National Health Insurance Corporation and who had a medical evaluation in 1992
Target population	Korean adult women (aged 30 to 95)
OR/RR/HR with 95% CI	(RR=2.00; 95% CI, 1.23 – 2.91)
Abstract 2	
First author, year	Jiang, 2015
Title	Effects of active, passive, and combined smoking on cervical cancer mortality: a nationwide proportional mortality study in Chinese urban women
DOI	10.1007/s10552-015-0580-x
Study design	Retrospective case-control study
Exposure variable	Cigarette smoking, in any form (passive, active, etc.)
Outcome variable	Development and mortality of cervical cancer
Study sample (n)	1,865 (aged 35+) women who died from cervical cancer (cases) 48,781 women who died from causes unrelated to smoking (controls)
Source population	Women who participated in a large national survey of smoking and mortality in 1989 – 1991
Target population	Chinese adult women (aged 35+)
OR/RR/HR with 95% CI	(RR=1.69; 95% CI, 1.27 – 2.26)
Abstract 3	
First author, year	Coker, 2009
Title	Smoking and survival among Kentucky women diagnosed with invasive cervical cancer: 1995 – 2005
DOI	10.1016/j.ygyno.2008.10.013
Study design	Prospective cohort study
Exposure variable	Cigarette smoking
Outcome variable	Mortality from cervical cancer
Study sample (n)	2,661 Kentucky women diagnosed with invasive cervical cancer
Source population	Women reported to the Kentucky Cancer Registry from 1995 – 2005 and linked with state vital records and the National Death Index through 12/31/2005
Target population	Adult women from Kentucky
OR/RR/HR with 95% CI	(HR=1.21; 95% CI, 1.01 – 1.46)

3.3 Interpretation

The first selected research abstract used a prospective cohort study design. This study determined that there was a statistically significant, positive correlation between smoking and cervical cancer mortality among Korean women. With the risk ratio being (RR=2.00; 95% CI, 1.23 – 2.91), this confirms that the results are significant and have a positive association due to the confidence interval being greater than 1. This also means that the p-value was less than 0.05. These results demonstrated that the relative risk of dying due to cervical cancer was 2.00 times higher in women who smoked as compared to women who did not smoke.

The second selected research abstract utilized a retrospective case-control study design. This study also determined that there was a statistically significant, positive association between smoking and cervical cancer mortality. However, this study was completed amongst Chinese urban women as opposed to the first abstract. The risk ratio was (RR=1.69; 95% CI, 1.27 – 2.26), which verifies that the results are in fact statistically significant. Given these results, they suggest that the relative risk of dying due to cervical cancer was 1.69 times higher among women who smoked as compared to women who did not smoke.

The third research abstract employed a prospective cohort study design. This study additionally found a statistically significant, positive association between smoking and cervical cancer mortality. The study was conducted using women from the state of Kentucky. This abstract used a hazard ratio as opposed to the risk ratios seen previously. A hazard ratio is often used in mortality/survival rates; however, the results are interpreted identically to risk ratios. The hazard ratio was (HR=1.21; 95% CI, 1.01 – 1.46), which confirmed that the results were also statistically significant. The results suggested that the risk of dying due to cervical cancer was 1.21 times higher among women who smoked as opposed to those who did not smoke.

4. Conclusion

After thorough analysis of the data and research abstracts, compiled evidence suggests that there is a statistically significant, positive association between smoking and cervical cancer mortality rates. A descriptive ecologic study using data obtained through FLHealthCharts.gov demonstrated that there is a weak, but statistically significant positive correlation between smoking prevalence and cervical cancer mortality rates in Florida counties (correlation coefficient: $r = 0.303$; p-value: 0.013). Odongua's prospective cohort study denoted that the relative risk of dying from cervical cancer was 2.00 times higher among women who smoked compared to those who did not. Likewise, Jiang's retrospective case-control study showed that the relative risk of dying from cervical cancer was 1.69 times higher among women who smoked compared to those who did not. Coker's prospective cohort study also determined that the risk of dying from cervical cancer was 1.21 times greater in women who smoked compared to those who did not. Ultimately, smoking has been a leading cause of preventable death among many diseases for numerous decades. And sadly, this is a statistic that will continue to afflict the world unless the appropriate measures are employed to reduce the prevalence of smoking. A global intervention consisting of educating and demonstrating the negative effects of smoking on the body can help reduce smoking prevalence (Fu & Lin, 2023). This can be used in conjunction with easy-to-follow resources consisting of tips from former smokers (Centers for Disease Control and Prevention, 2024). These coupled with smoking cessation programs can help facilitate a healthier world and hopefully decrease not only the mortality rates, but the incidence and prevalence rates of many diseases in the near and long-lasting future.

5. References

Behavioral Risk Factor Surveillance System (BRFSS) Dashboard - Florida Health CHARTS - Florida Department of Health. (2019). https://www.flhealthcharts.gov/ChartsDashboards/rdPage.aspx?rdReport=BRFSS.Dataviewer&bid=8

Cervical cancer risk factors | Risk factors for cervical cancer. (2020, January 3). American Cancer Society. https://www.cancer.org/cancer/types/cervical-cancer/causes-risks-prevention/risk-factors.html

Cervical cancer symptoms. (2022, October 13). National Cancer Institute. https://www.cancer.gov/types/cervical/symptoms

Cervical cancer - Symptoms and causes - Mayo Clinic. (2023, September 2). Mayo Clinic. https://www.mayoclinic.org/diseases-conditions/cervical-cancer/symptoms-causes/syc-20352501#:~:text=Cervical%20cancer%20happens%20when%20cells,accumulate%20in%20growths%20called%20tumors.

Coker, A. L., DeSimone, C. P., Eggleston, K. S., Hopenhayn, C., Nee, J., & Tucker, T. C. (2009). Smoking and survival among Kentucky women diagnosed with invasive cervical cancer: 1995–2005. *Gynecologic Oncology*, *112*(2), 365–369. https://doi.org/10.1016/j.ygyno.2008.10.013

Deaths from cervical cancer. (2023). FL Health CHARTS - Florida Department of Health. https://www.flhealthcharts.gov/ChartsDashboards/rdPage.aspx?rdReport=Death.Female.DataViewer&cid=0087

Fu, D., & Lin, X. J. (2023). The progress of the global tobacco cessation strategies. *China CDC Weekly*, *5*(21), 475–478. https://doi.org/10.46234/ccdcw2023.090

Jiang, J., Pang, H., Liu, B., Nasca, P. C., Zhang, B., Wu, Y., Han, W., Gates, M. A., Lu, T., Zou, X., Xue, F., Hou, L., Wang, Z., Wang, Y., Chen, Y., & Li, J. (2015). Effects of active, passive, and combined smoking on cervical cancer mortality: a nationwide proportional mortality study in Chinese urban women. *CCC. Cancer Causes & Control/CCC, Cancer Causes & Control*, *26*(7), 983–991. https://doi.org/10.1007/s10552-015-0580-x

Odongua, N., Chae, Y. M., Kim, M., Yun, J. E., & Jee, S. H. (2007). Associations between Smoking, Screening, and Death Caused by Cervical Cancer in Korean Women. *Yonsei Medical Journal/Yonsei Medical Journal*, *48*(2), 192. https://doi.org/10.3349/ymj.2007.48.2.192

Tips from former smokers. (2024, January 8). Centers for Disease Control and Prevention. https://www.cdc.gov/tobacco/campaign/tips/index.html