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Cervical cancer screening among women with comorbidities: a cross-sectional examination of disparities from the behavioral risk factor surveillance system

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Abstract

Context: Implementation of guideline-based Papanicolaou (Pap) smear screening, human papillomavirus (HPV) testing, and HPV vaccination has reduced cervical cancer (CC) rates up to 80%, yet prevention disparities continue to exist. Objectives: This study aims to analyze whether CC screening rates differ among women with comorbidities—body mass index (BMI) ≥30 kg/m², diabetes mellitus, hypertension, cardiovascular disease, chronic obstructive pulmonary disease (COPD), arthritis, kidney disease, depression, or skin cancer—compared to women without these comorbidities. Methods: Combined 2018 and 2019 Behavioral Risk Factor Surveillance System (BRFSS) datasets were evaluated utilizing multivariate logistic regression models to determine the adjusted odds ratios (AORs) of persons having completed CC screening without comorbidities compared to those with individual diagnoses, as well as in those with multiple comorbidities (1, 2–4, 5+). Confidence intervals (CIs) were reported at 95%.

Results: Among the 127,057 individuals meeting inclusion criteria, 78.3% (n = 83,242; n = 27,875,328) met CC screening guidelines. Multivariable regression showed that women who had a BMI ≥30 kg/m² were significantly less likely to have completed a CC screening (AOR: 0.90; CI: 0.83–0.97) as were those with COPD (AOR: 0.77; CI: 0.67–0.87) and kidney disease (AOR: 0.81; CI: 0.67–0.99). Conversely, women with skin cancer were significantly more likely to report CC screening (AOR: 1.22; CI: 1.05–1.43). We found no significant differences in CC screening completion rates by diagnosis of diabetes, hypertension, cardiovascular disease, arthritis, or depression nor between women lacking comorbidities compared to women with multiple comorbidities.

Conclusions: Women with BMI ≥30 kg/m², COPD, and kidney disease were less likely to complete CC screening, whereas women with skin cancer were more likely to complete CC screening. Additionally, diabetes mellitus, hypertension, cardiovascular disease, arthritis, and depression diagnoses did not significantly impact rates of CC screening. Physicians should be aware of the deviations in CC screening completion among patients with diagnoses to know when there may be an increased need for Pap tests and pelvic examinations. CC screening is critical to reduce mortality through early detection and prevention measures.

Keywords: behavioral risk factor surveillance system; BRFSS; cervical cancer; comorbidities; HPV.

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development of CC, with an infection rate as high as 80% [2]. The evolution of new technology for cancer intervention has allowed for the development of primary (prophylactic HPV vaccination) and secondary prevention (HPV screening via Papanicolaou [Pap] smear) tools that have been instrumental in reducing CC rates [3]. Nonetheless, research has shown disparities in vaccination usage [4]; thus, guideline-based screening remains a critical intervention for reducing the morbidity and mortality of CC [4].

The presence of comorbid diagnoses may be one factor that is affecting CC screening rates. For example, evidence has shown that people with body mass index (BMI) ≥30 kg/m² are less likely to receive colorectal cancer screening [5]. Another study showed that individuals diagnosed with diabetes, hypertension, arthritis, or depression were more likely to be screened for colon cancer [6], which supports the premise that the presence of comorbid conditions is related to deviations in the likelihood of receiving evidence-based cancer screenings. Another study supporting this theory found that among 118,742 women diagnosed with breast cancer, self-reported mammography completion was higher among those who had three or more comorbidities [7]. Lastly, Liu et al. [8] found that among nearly 3,400 patients over the age of 55, comorbidity conditions such as arthritis, hypertension, and diabetes mellitus were associated with a lower likelihood of adherence to multiple cancer screening guidelines—including CC.

Given the previous evidence suggesting associations between the absence or presence of comorbidities with an individual completing CC screening and the impact of having multiple comorbidities on screening compliance, we expand the literature on this subject by utilizing a nationally representative dataset with the ability to incorporate a wider age range—matching CC screening guidelines from the American College of Obstetricians and Gynecologists (ACOG). Thus, our primary objective was to analyze CC screening completion rates among individuals with and without diabetes, hypertension, cardiovascular disease, chronic obstructive pulmonary disease (COPD), arthritis, kidney disease, depression, or skin cancer utilizing data extracted from the Center for Disease Prevention and Control’s Behavioral Risk Factor Surveillance System (BRFSS). Our secondary objectives were to determine if the presence of multiple comorbidities impacted screening completion rates and to investigate potential disparities in CC screening rates based on race/ethnicity, age, education, and healthcare coverage.

**Methods**

To conduct this observational study, we combined the 2018 and 2019 BRFSS datasets and performed a cross-sectional analysis to examine CC screening prevalence among women with and without comorbid conditions. BRFSS (https://www.cdc.gov/brfss/about/index.htm) is a national telephone survey that collects demographic, behavioral, and health-related information from noninstitutionalized individuals from all 50 states, Guam, Puerto Rico, and the District of Columbia. Surveys are administered through cell and landline phones, which are divided into strata based upon proximity to other area codes, and randomly sampled. With this method of data collection, it should be noted that the data could have inaccuracies and response biases, preventing conclusions from being made directly from data analysis. BRFSS collects data from approximately 450,000 respondents across the United States and applies a weighting schema to approximate the total US population.

Respondents were classified as having a CC screening through the following questions: “Have you ever had a Pap [smear] test?” or “Have you ever had an HPV test?” Those answering affirmatively to either of those questions and affirming that they were conducted within the past 3 years were coded as having been screened. Those responding “no” to both of those questions or reporting that their cervical examination occurred outside of the 3-year window were coded as not having a current screening. We concurrently extracted sociodemographic data, including education level, race/ethnicity, healthcare coverage, age (in 5-year increments), and gender, as well as the previously mentioned comorbidities. The reason that race/ethnicity was assessed in the study was to identify a potential racial health disparity in CC screening. Race/ethnicity of study participants was classified by the participants themselves. Given the 3-year window and the United States Preventive Services Task Force’s (USPSTF) recommendation for CC screening to occur starting at 21 years of age and continuing every 3 years until age 65, individuals aged 24 and under, and those 65 and over were excluded from this study. Further, we excluded women with hysterectomies because they would no longer require CC screening.

Utilizing the combined datasets, including sampling weights provided by BRFSS (adjusted to match the multiple cycles of data), we calculated the unweighted (within sample; n) and weighted (representative of the United States resident population; N) prevalence of CC screening among individuals with and without comorbidities. We then constructed multivariate logistic regression models to determine the adjusted odds ratios (AORs) of persons who completed CC screening with and without comorbidities. To assess our secondary objective, we constructed a regression model to determine the likelihood of individuals with multiple comorbidities (1, 2–4, 5+) having completed a CC screening. Regression models were adjusted for race, age, healthcare coverage, and education level. A post hoc binary logistic regression model was constructed to assess the association of race, via odds ratios (ORs), on CC screening. Sampling weights, provided by BRFSS, were adjusted to account for the combined datasets for population-level estimates. Statistical analyses were performed utilizing Stata 16.1 (StataCorp, LLC, College Station, TX) in December 2020.

**Results**

**Sample and population size**

There were 855,704 respondents who completed the survey for combined years. After excluding men and women under the age of 25 and over 65, the sample size was 127,057,
representing a population size ($N$) of 40,157,472 women in the United States. The following results are reported in weighted percentages with 95% confidence intervals (CIs).

**Participant demographics among CC-screened and -unscreened groups**

Among the participants, 78.3% ($CI: 77.9–78.8; n = 83,242; N = 27,875,328$) met the CC screening guidelines. The screening guidelines and racial distributions of both groups are reported in Table 1. Women aged 30–34 years (15.2%, $CI: 14.8–15.7$) met the guidelines most often, while women between the ages of 60–64 years represented the largest group who did not meet the USPSTF criteria. Of those who did not meet the screening guidelines, 24.34% ($CI: 22.88–25.87$) were uninsured. Alternatively, among the women who did meet the screening guidelines, 11.05% ($CI: 10.58–11.54$) lacked health insurance. The distribution of women who did and did not meet the screening guidelines was similar among those who reported some college or less education, but graduates of college or tech school differed by 12.1% between groups (Table 1), with more women in this group completing screening guidelines.

**Associations of CC screening and co-occurring conditions**

The multivariable regression model showed that women with a BMI ≥30 kg/m² had a lower chance of completing a CC screening (AOR: 0.90; $CI: 0.83–0.97; p = 0.009$; Table 2). This was also the case in women with COPD (AOR: 0.77; $CI: 0.67–0.87; p < 0.001$) and kidney disease (AOR: 0.81; $CI: 0.67–0.99; p = 0.047$). Conversely, the odds of women who have been diagnosed with skin cancer showed that they were more likely to report completing CC screening (AOR: 1.22; $CI: 1.05–1.43; p = 0.01$). We found no significant association in CC screening completion between women with diabetes, hypertension, cardiovascular disease, arthritis, or depression.

There was no statistically significant difference in CC screening completion between women without comorbidities compared to those with multiple comorbidities (Table 2).

**Post-hoc analysis**

Our results showed that Black (OR: 1.57; $CI: 1.40–1.76$; Table 1) and Hispanic women (OR: 1.15; $CI: 1.03–1.29$) were
Table 2: Prevalence of co-occurring diagnoses and adjusted odds ratios (AORs) in women who answered yes or no to questions about cervical cancer screening (n = 127,057; n = 40,157,472).

| Diagnosis                  | Not screened n = 18,615 | Screened n = 96,568 | AOR (95% CI)  | p-Value |
|----------------------------|-------------------------|---------------------|---------------|---------|
| Obesity                    | 34.85 (33.26–36.47)     | 32.51 (31.84–33.19) | 0.90 (0.83–0.97) | 0.009   |
| Diabetes                   | 13.29 (12.29–14.36)     | 12.11 (11.62–12.62) | 1.02 (0.92–1.14) | 0.63    |
| Blood pressure             | 29.37 (20.48–40.17)     | 29.31 (25.49–33.44) | 1.13 (0.61–2.09) | 0.70    |
| Cardiovascular disease     | 0.41 (0.31–0.54)        | 0.34 (0.27–0.43)    | 1.09 (0.75–1.59) | 0.64    |
| Skin cancer                | 3.07 (2.66–3.54)        | 3.45 (3.25–3.66)    | 1.22 (1.05–1.43) | **0.01**|
| COPD                       | 7.66 (6.95–8.42)        | 4.96 (4.63–5.31)    | 0.77 (0.67–0.87) | <0.001  |
| Arthritis                  | 22.88 (21.73–24.08)     | 20.41 (19.89–20.94) | 0.99 (0.92–1.07) | 0.79    |
| Depression                 | 24.59 (23.39–25.83)     | 23.29 (22.73–23.87) | 0.97 (0.90–1.04) | 0.40    |
| Kidney disease             | 2.713 (2.29–3.21)       | 1.95 (1.78–2.14)    | 0.81 (0.67–0.99) | **0.047**|

Comorbidities (compared to 0)

|     | Not screened n = 18,615 | Screened n = 96,568 | AOR (95% CI)  | p-Value |
|-----|-------------------------|---------------------|---------------|---------|
| 1   | 30.14 (28.66–31.65)     | 31.59 (30.94–32.25) | 1.02 (0.94–1.11) | 0.592   |
| 2+  | 27.64 (26.34–28.99)     | 24.39 (23.8–24.98)  | 0.94 (0.86–1.02) | 0.134   |
| 5+  | 1.08 (0.85–1.38)        | 0.74 (0.64–0.84)    | 0.82 (0.61–1.10) | 0.178   |

a. Blood pressure questions were only available for 2019. b. Cardiovascular disease is assessed either by answering “yes” to having angina, a heart attack, or a stroke. Diabetes included those answering affirmatively to having diabetes mellitus (type 1 or 2), pre-diabetes, or gestational diabetes. Regression models controlled for race, age, education, and health insurance. AOR, adjusted odds ratio; CI, confidence interval; COPD, chronic obstructive pulmonary disease. p-Values <0.05 were bolded.

significantly more likely to have completed a screening for CC in the past 3 years compared to white women, whereas Asian women were less likely (OR: 0.67; CI: 0.56–0.80) and Native American women were not significantly different (OR: 0.78; CI: 0.54–1.08).

Discussion

Our results showed that women between the ages of 25 and 65 had differing rates of CC screening completion by co-occurring diagnoses—with lower rates of screening completion among those with diagnoses of obesity, COPD, or kidney disease, and higher rates among those with skin cancer. We identified no significant difference in CC screening completion among persons with diabetes, hypertension, cardiovascular disease, arthritis, depression, or multiple comorbidities. Our post hoc analysis found that White women between the ages of 25 and 65 were less likely to complete a CC screening when compared to Black or Hispanic women.

Our results are consistent with a smaller preceding study highlighting similar rates of screening completion for CC among women with comorbidities [8]. Notably, the present study analyzed more comorbid conditions, in addition to utilizing a nationally representative sample, and it identified a particularly concerning feature; women with BMI ≥30 kg/m² were significantly less likely to complete CC screening. This is especially worrisome due to the associations between obesity and the risk of CC [9, 10]. Interestingly, in a systematic review by Fagan et al. [10], five studies examined associations between CC screening completion and obesity among White women—all reporting negative correlations—although studies of Black women showed either no relationship or a possible interaction in screening completion rates and socioeconomic status. Although this was specific to obesity and CC, we posit that there may be several reasons for our findings, including personal factors such as perceived costs, lack of healthcare access [11], and health literacy [12].

Our findings are also consistent with previous literature regarding the associations between CC screening and healthcare coverage [11]. Insufficient healthcare coverage is often accompanied by or is a product of poverty or chronic illnesses [13]. Evidence has shown that healthcare costs are a primary barrier to healthcare coverage and access [14]. Another study found that perceptions of screening costs varied widely, including the expense of transportation, time missed from work, and future treatment [15]. Lastly, whereas previous literature has reported low CC screening among women with comorbidities [16, 17], our study contributes new findings suggesting that Black and Hispanic women are more likely to complete screening for CC compared to White women. This may indicate that
targeted preventative education and community efforts are working [18], especially considering that these groups have higher rates of CC risk factors [19, 20].

Poor health literacy may also be impacting uptake of CC screening. A study by Akinlotan et al. [14] found that risk factor knowledge and educational attainment were significantly associated with decreased rates of CC screening. This study showed that less than half of the 433 women included were able to identify that smoking, long-term birth control, and multiple children were factors that increased the risk for CC, yet only 60.5% identified multiple sex partners as a risk. Further, 69% of White women reported cost as a barrier to CC screening completion compared to 59.7% of Black women and 57.6% of Hispanic women [14].

Health literacy may be impeded due to conflicting recommendations among professional organizations. Some women may be unaware that a “Pap smear” is often included in “routine pelvic exams” in clinical settings [21]. However, ACOG, the American College of Physicians, the American Academy of Family Physicians, the Society of Gynecologic Oncology, and the USPSTF do not include cancer screenings as components of pelvic examinations, although they are often performed at the same time. ACOG recommendations regarding the frequency of pelvic examinations are left to patient-provider determination (unlike CC screenings at specified intervals) [21, 22] stating that there is insufficient evidence “to support a recommendation for or against performing a routine screening pelvic examination among asymptomatic, nonpregnant women who are not at increased risk of any specific gynecologic condition.” [23] Therefore, clear and concise terminology regarding Pap smears and pelvic examinations may be crucial in evaluating CC screening rates.

As ACOG recommends annual visits to the obstetrician-gynecologist, they note that this is an opportune time to enhance patient-provider relationships and reassure women of their health status [23]. This is a time in which providers and skilled teams may improve patients’ health literacy and together make the most suitable health plan for the patients. Further, as a result of patient-related time constraints, improvements in skilled communication, patient-centered language, complete wrap-around services, and collaboration with other healthcare team members may improve the quality of care. Another factor that may impede CC screening is the quality of care for currently diagnosed medical conditions. The relationship between quality of care and preventive cancer screenings has shown a positive correlation among a previous study of women with diabetes that showed a positive association with more complete diabetes care and was related to the completion of CC screenings [24].

Indications for community health and clinical practice

Each of these limiting factors may be improved with a unified, global message regarding the importance of women’s health and access to health services that should be applied to all primary care settings, not just in racial/ethnic minority communities or gynecological-focused clinics. Studies have shown that CC education, including risks and information about Pap tests, increases the likelihood that women complete CC screening [22, 23]. This would allow for increased exposure to information regarding CC screening and opportunities for education. In turn, this may translate into increased interaction with providers and referrals. Further strategies that improve CC screening completion should be multifaceted and should be addressed at the individual and community levels. The coordination of healthcare between clinical settings, social service, and nonprofit organizations may help overcome barriers to screening for underserved or low-income populations. These organizations can often provide direct services as well as transportation and financial support [25, 26]. In addition to informing patients in-person, mailed and phone call invitations to receive screening and reminders of appointments have been shown to increase screening rates [27].

Limitations

The BRFSS data utilized for this study consisted of a large sampling size and thus provided sufficient statistical strength for data analysis. However, because of the nature of the data provided from BRFSS, this article is only observational. A limitation in utilizing BRFSS data is the method and environment of data collection via self-reporting survey, thus, response bias and inaccuracies could exist, negatively impacting results. Further, although we followed the USPSTF screening guidelines for CC—every 3 years with cervical cytology for women aged 21 to 65 years—some women may opt to have high-risk human papillomavirus (hrHPV) testing alone or in combination with cytology (co-testing), both of which are provided at 5-year increments after age 30 [28]. Although we could not find the rates of women who opted for the 5-year tests, the NIH also states that a safe retest period for a dual test is 3 years, reporting that “the findings suggest that HPV-positive women with a positive dual-stain test result should have a biopsy to check for cervical precancer or cancer, the study authors concluded, whereas those with a negative result can safely wait 3 years before being screened again.” [29] which is supported by an NIH- and NCI-funded article published in
Conclusions

We identified key findings among women with comorbidities who completed CC screenings utilizing a nationally representative sample. Women with BMI ≥30 kg/m², COPD, and kidney disease were significantly less likely to receive guidelines recommending CC screening. We found no significant associations between CC screening completion and women with multiple, compared to zero, comorbidities. Improving CC screening uptake is critical for reducing the morbidity and mortality of CC. Physicians should be aware of the disparities in CC screening completion among patients with comorbid diagnoses to recognize when there may be an increased need for Pap tests during well-woman visits.

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Competing interests: None reported.

Ethical approval: Based on the information provided by our application, the OSU-Stillwater Institutional Review Board (IRB) determined that our project did not qualify as human subject research as defined in 45 CFR 46.102 (d) and (f) and is not subject to oversight by the OSU IRB.

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