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ORIGINAL PAPER

Breast and cervical cancer screenings across gender identity: results from the Behavioral Risk Factor Surveillance System before and during the COVID-19 pandemic

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Abstract

Purpose Although national medical organizations often neglect to include trans and gender diverse (TGD) people in their breast and cervical cancer screening recommendations, the World Profession Association of Transgender Health recommends that TGD people who are at risk for these cancers follow existing guidelines for cisgender women. Despite WPATH's recommendations, TGD people are less likely to get screened in large part due to discrimination. The COVID-19 pandemic has limited access to cancer screenings among cisgender people, but it is unknown how this has impacted TGD people.

Methods Using national survey data from the Behavioral Risk Factors Surveillance System (BRFSS), we examined differences in cervical and breast cancer screening noncompliance across gender identity at two time points: before and during the COVID-19 pandemic.

Results Screening noncompliance increased during the COVID-19 pandemic among cisgender and TGD people (e.g., transgender men, gender non-conforming people). Compared to cisgender women, transgender men and gender non-conforming respondents had higher odds of breast cancer screening noncompliance before and during COVID-19. Transgender men had lower odds of cervical cancer screening noncompliance than cisgender women before COVID-19, but higher odds during the pandemic. Gender non-conforming respondents also had lower odds of cervical cancer screening noncompliance during COVID-19 compared to cisgender women.

Conclusions Screening noncompliance for breast and cervical cancer was more common among TGD people than cisgender women; while these disparities existed before the COVID-19 pandemic, they were exacerbated during the pandemic. Future work should move beyond descriptive statistics and elucidate underlying causes to inform interventions.

Keywords Breast cancer · Cervical cancer · Screening · Transgender · Gender · COVID-19

Introduction

Mortality rates for both breast and cervical cancer have decreased since the late 1900s, in part because of the introduction of routine Papanicolaou (Pap) tests, human papillomavirus (HPV) tests and vaccination, and mammography [1]. Many medical organizations, including the American Cancer Society (ACS), U.S. Preventative Task Force (USPSTF), and the American College of Obstetricians and Gynecologists (ACOG) have breast and cervical cancer screening recommendations, but do not make note of whether these recommendations are suitable for trans and gender diverse (TGD) patients. However, the most recent care guidelines from the World Profession Association of Transgender Health (WPATH) recommend that breast cancer screenings be offered to TGD patients who have received estrogen or with breasts from natal puberty following guidelines for cisgender women; WPATH recommends that cervical cancer screenings be offered to TGD patients who have had or who currently have a cervix following guidelines for cisgender women [2]. Despite these recommendations, previous studies have shown that transgender men were less likely to be up-to-date on Pap tests compared to cisgender

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women [3] and transgender men were less likely to have mammograms at the recommended intervals compared to cisgender women [4, 5].

TGD people may avoid interactions with the healthcare system to limit experiences of discrimination [6]. Stroumsa et al. found that transphobia, and not hours of education, informed provider knowledge of TGD care, illustrating the impact of systemic transphobia as a barrier to healthcare for TGD patients [7]. Additionally, problems with health insurance coverage, physical discomfort, and experiences of dysphoria can deter patients from having cancer screenings [8, 9]. We know that structural systems of oppression like racism [10–12] and transphobia [13, 14], have decreased the quality and number of healthcare encounters that individuals with marginalized identities experience, and that the COVID-19 pandemic exacerbated these inequities. The pandemic has limited access to cancer screenings among cisgender individuals [15, 16] and screening disparities between cisgender and TGD populations have likely only widened in recent years because of the differential impact of COVID-19. TGD people have unique physical health and healthcare access vulnerabilities that are impacted by COVID-19 in ways that cisgender people do not experience [17]. For example, during the pandemic many facilities deferred preventative testing for sexually transmitted infections (STIs) to minimize COVID-19 exposure in clinical settings, even though these delays may have resulted in worse clinical outcomes for the STIs [18]. TGD people experience a disproportionate burden of STIs [19], and could have experienced increases in HPV and cervical cancer risk.

It is uncommon for gender identity measures to be routinely included in electronic health records and nationwide databases, making it difficult to understand screening behaviors in the TGD population. The goal of this study is to utilize the Behavioral Risk Factors Surveillance System (BRFSS) to compare the use of cancer screenings between TGD and cisgender populations in a nationally representative sample at two time points—before and during COVID-19. Elucidating gender identity-related screening disparities can inform the development of tailored screening guidelines or interventions. This study aims to: (1) assess differences in cervical and breast cancer screening across gender identity; and (2) assess the impact of the COVID-19 pandemic on cervical and breast cancer screening across gender identity.

Methods

Publicly available data from the 2018, 2019, 2020, and 2021 Behavioral Risk Factor Surveillance System (BRFSS), a cross-sectional telephone survey of U.S. residents, were used to compare breast and cervical cancer screening compliance among cisgender and TGD respondents. Analyses were limited to participants who responded to the gender identity question.

Gender

Questions regarding breast and cervical cancer screening were only asked to individuals who reported female sex. Therefore, gender identity was categorized using the questions: 'Are you male or female?' with response options *Male* and *Female* and 'Do you consider yourself to be transgender?'. If yes, response options were *male to female, female to male,* and *gender non-conforming*. The gender variable was computed based on responses to both questions as follows: cisgender women (*female* and *no*), gender non-conforming (*female* and *transgender, gender non-conforming*), and transgender men (*female* and *transgender, female to male*).

Breast cancer screening

Breast cancer screening compliance was computed using the questions: 'Have you ever had a mammogram?' and 'How long has it been since you had your last mammogram?' in accordance with ACOG recommendations [20]. Individuals under 40 years old were excluded from this analysis. Individuals were considered compliant if they were 40 years or older, answered *yes* to the first question, and had had a mammogram within the last two years. Responses from individuals who reported *don't know* or who refused to answer the first question were excluded due to low count.

Cervical cancer screening

For the 2018, 2019, and 2020 data, cervical cancer screening compliance was computed using the questions: 'Have you ever had a Pap test?', 'How long has it been since you had your last Pap test?', 'Have you ever had an HPV test?', and 'How long has it been since you had your last HPV test?'. For the 2021 data, the following questions were used: 'At your most recent cervical cancer screening, did you have a Pap test?', 'At your most recent cervical cancer screening, did you have an HPV test?', 'How long has it been since you had your last cervical cancer screening test?'. Individuals under 24 years old and those who reported a hysterectomy were excluded from this analysis. Individuals were considered compliant if they were between 25 and 29 years old and had a Pap test or an HPV test alone within the last three years, or over 30 years old and had a pap and HPV test in the last five years, or a pap test alone in the last three years, or an HPV test alone in the last three years, in accordance with ACOG recommendations [21]. Responses from individuals who reported *don't know* or who refused to answer the first question were excluded due to low count.

Covariates

Covariates included age (in ~ 5-year increments), race/ethnicity (white/non-Hispanic, Black/non-Hispanic, Asian/non-Hispanic, American Indian/Alaskan Native/non-Hispanic, Hispanic, Other race/non-Hispanic), and region (Midwest, Northeast, South, U.S. Territory,[1] West).

Statistical analysis

Data from 2018 and 2019 were combined to estimate differences in screening across gender identity before the COVID-19 pandemic began whereas data from 2020 and 2021 were combined to estimate differences during the pandemic.

Multivariable logistic regression models were used to examine odds ratios (OR) and 95% confidence intervals (CI) of breast and cervical cancer screening compliance between the reference group of cisgender women and two groups of TGD people: transgender men and gender non-conforming people. Models were adjusted for age, race/ethnicity, and region. Sensitivity analyses were conducted where we excluded individuals who reported previous breast and cervical cancer diagnoses from their respective analyses. BRFFS weights, which are typically used, rely on participants' reported sex and may not eliminate bias in studies where gender is a key factor [22]. Because of high sex/gender discordance among the transgender respondents, weights were not used in this analysis.

All analyses were conducted in R, version 4.2.2 in 2023.

These data do not include identifiable information, and do not meet the requirements of human subjects' research; therefore, IRB approval was not needed.

Results

Overall, 510,562 cisgender women, 1,036 transgender men, and 639 gender non-conforming people were included in the analysis (Table 1). Most respondents fell within an age range where breast and cervical cancer screening would be recommended. Of the participants included in this analysis, 39.6% of cisgender women, 25.8% of transgender men, and 17.1% of gender non-conforming people answered questions regarding breast cancer screening. A total of 12.5% of cisgender women, 9.7% of transgender men, and 9.5% of gender non-conforming people answered questions regarding cervical cancer screening.

[1] U.S. territories reporting to BRFSS include Puerto Rico, Guam, and the Virgin Islands.

Before COVID-19, 29.1% of all respondents were compliant with breast cancer screening and 11.4% were compliant with cervical cancer screening. When stratified by gender identity, 29.2% of cisgender women were compliant with breast cancer screening pre-pandemic, while only 24.4% of transgender men and 15.9% of gender non-conforming people were compliant. A total of 11.4% of cisgender women were compliant with cervical cancer screening, while 11.6% of transgender men and 9.3% of gender non-conforming people were compliant with the recommendations.

During COVID-19, breast cancer screening compliance fell to 27.8% among all respondents, and cervical cancer screening compliance increased by 0.2%. During COVID-19, 27.9% of cisgender women were compliant with breast cancer screening, while only 10.8% of transgender men and 8.7% of gender non-conforming people were compliant. A total of 11.6% of cisgender women were compliant with cervical cancer screening, while only 6.7% of transgender men and 8.7% of gender non-conforming people were compliant.

Compared to cisgender respondents before COVID-19, the adjusted odds of noncompliance for breast cancer screening were greater among transgender men (OR = 1.14, 95% CI 0.41–2.75) and gender non-conforming respondents (OR = 1.39, 95% CI 0.30–5.00) (Table 2). During COVID-19, transgender men (OR = 2.39, 95% CI 1.03–5.48) and gender non-conforming respondents (OR = 1.75, 95% CI 0.53–5.29) had higher odds of breast cancer screening noncompliance compared to cisgender women. These results were consistent in the sensitivity analysis, where individuals with a breast cancer diagnosis were excluded from the analysis.

Adjusted odds ratios for cervical cancer screening compliance show that transgender men had lower odds of being non-compliant before COVID-19 (OR = 0.84, 95% CI 0.13– 2.86), and higher odds of being non-compliant during COVID-19 (OR = 2.04, 95% CI 0.67–5.15). During COVID-19, gender non-conforming people had lower odds of cervical cancer screening noncompliance compared to cisgender women (OR = 0.73, 95% CI 0.04–3.74). These results were consistent in the sensitivity analysis where individuals with a cervical cancer diagnosis were excluded (Table 3).

Discussion

Adjusted logistic regressions suggest there are meaningful differences in breast and cervical cancer screening compliance before and during the COVID-19 pandemic across gender identity. Almost all groups saw a decrease in screening compliance for both breast and cervical cancer once the pandemic began. Compared to cisgender women, TGD respondents were more likely to be non-compliant with breast cancer screening recommendations before and during COVID-19.

Table 1 Sample characteristics among behavioral risk factors surveillance system respondents assigned female at birth by gender identity

	Cisgender women		Gender non-conforming		Transgender Men		Overall	
	Pre-Covid (*N* = 253,796)	During Covid (*N* = 256,766)	Pre-Covid (*N* = 246)	During Covid (*N* = 393)	Pre-Covid (*N* = 450)	During Covid (*N* = 586)	Pre-Covid (*N* = 254,492)	During Covid (*N* = 257,745)
Age								
18–24	11,179 (4.4%)	12,921 (5.0%)	75 (30.5%)	147 (37.4%)	70 (15.6%)	97 (16.6%)	11,324 (4.4%)	13,165 (5.1%)
25–29	10,221 (4.0%)	11,352 (4.4%)	19 (7.7%)	71 (18.1%)	42 (9.3%)	40 (6.8%)	10,282 (4.0%)	11,463 (4.4%)
30–34	12,341 (4.9%)	14,154 (5.5%)	22 (8.9%)	36 (9.2%)	27 (6.0%)	33 (5.6%)	12,390 (4.9%)	14,223 (5.5%)
35–39	14,139 (5.6%)	16,284 (6.3%)	17 (6.9%)	31 (7.9%)	34 (7.6%)	31 (5.3%)	14,190 (5.6%)	16,346 (6.3%)
40–44	14,500 (5.7%)	17,129 (6.7%)	7 (2.8%)	22 (5.6%)	29 (6.4%)	34 (5.8%)	14,536 (5.7%)	17,185 (6.7%)
45–49	16,210 (6.4%)	17,183 (6.7%)	13 (5.3%)	13 (3.3%)	19 (4.2%)	32 (5.5%)	16,242 (6.4%)	17,228 (6.7%)
50–54	20,015 (7.9%)	20,267 (7.9%)	11 (4.5%)	11 (2.8%)	33 (7.3%)	35 (6.0%)	20,059 (7.9%)	20,313 (7.9%)
55–59	24,428 (9.6%)	22,956 (8.9%)	10 (4.1%)	11 (2.8%)	32 (7.1%)	42 (7.2%)	24,470 (9.6%)	23,009 (8.9%)
60–64	27,905 (11.0%)	26,357 (10.3%)	14 (5.7%)	12 (3.1%)	44 (9.8%)	54 (9.2%)	27,963 (11.0%)	26,423 (10.3%)
65–69	28,172 (11.1%)	26,724 (10.4%)	15 (6.1%)	13 (3.3%)	39 (8.7%)	47 (8.0%)	28,226 (11.1%)	26,784 (10.4%)
70–74	26,170 (10.3%)	25,739 (10.0%)	13 (5.3%)	11 (2.8%)	28 (6.2%)	46 (7.8%)	26,211 (10.3%)	25,796 (10.0%)
75–79	19,444 (7.7%)	18,146 (7.1%)	14 (5.7%)	5 (1.3%)	22 (4.9%)	37 (6.3%)	19,480 (7.7%)	18,188 (7.1%)
80+	24,479 (9.6%)	22,623 (8.8%)	11 (4.5%)	8 (2.0%)	25 (5.6%)	48 (8.2%)	24,515 (9.6%)	22,679 (8.8%)
Missing	4,593 (1.8%)	4,931 (1.9%)	5 (2.0%)	2 (0.5%)	6 (1.3%)	10 (1.7%)	4,604 (1.8%)	4,943 (1.9%)
Race/Ethnicity								
White, Non-Hispanic	194,126 (76.5%)	195,685 (76.2%)	163 (66.3%)	260 (66.2%)	281 (62.4%)	414 (70.6%)	194,570 (76.5%)	196,359 (76.2%)
Black, Non-Hispanic	240,08 (9.5%)	19,002 (7.4%)	25 (10.2%)	22 (5.6%)	41 (9.1%)	52 (8.9%)	24,074 (9.5%)	19,076 (7.4%)
Asian, Non-Hispanic	6,204 (2.4%)	7,013 (2.7%)	4 (1.6%)	15 (3.8%)	25 (5.6%)	18 (3.1%)	6,233 (2.4%)	7,046 (2.7%)
AI/AN[a], Non-Hispanic	3,585 (1.4%)	4,200 (1.6%)	3 (1.2%)	10 (2.5%)	9 (2.0%)	12 (2.0%)	3,597 (1.4%)	4,222 (1.6%)
Hispanic	16,515 (6.5%)	21,521 (8.4%)	31 (12.6%)	46 (11.7%)	60 (13.3%)	69 (11.8%)	16,606 (6.5%)	21,636 (8.4%)
Other race, Non-Hispanic	9,358 (3.7%)	9,345 (3.6%)	20 (8.1%)	40 (10.2%)	34 (7.6%)	21 (3.6%)	9,412 (3.7%)	9,406 (3.6%)
Region								
Midwest	52,848 (20.8%)	78,060 (30.4%)	43 (17.5%)	125 (31.8%)	102 (22.7%)	113 (19.3%)	52,993 (20.8%)	78,298 (30.4%)
Northeast	52,030 (20.5%)	48,479 (18.9%)	47 (19.1%)	73 (18.6%)	72 (16.0%)	86 (14.7%)	52,149 (20.5%)	48,638 (18.9%)
South	100,545 (39.6%)	61,514 (24.0%)	100 (40.7%)	77 (19.6%)	171 (38.0%)	257 (43.9%)	100,816 (39.6%)	61,848 (24.0%)
Territory	1,898 (0.7%)	1,057 (0.4%)	1 (0.4%)	0 (0%)	15 (3.3%)	5 (0.9%)	1,914 (0.8%)	1,062 (0.4%)
West	46,475 (18.3%)	67,656 (26.3%)	55 (22.4%)	118 (30.0%)	90 (20.0%)	125 (21.3%)	46,620 (18.3%)	67,899 (26.3%)
Had hysterectomy								
Yes	36,201 (14.3%)	34,178 (13.3%)	27 (11.0%)	17 (4.3%)	52 (11.6%)	37 (6.3%)	36,280 (14.3%)	34,232 (13.3%)
No	89,721 (35.4%)	94,593 (36.8%)	91 (37.0%)	126 (32.1%)	184 (40.9%)	149 (25.4%)	89,996 (35.4%)	94,868 (36.8%)
Don't know/ Not sure	274 (0.1%)	274 (0.1%)	0 (0%)	0 (0%)	1 (0.2%)	1 (0.2%)	275 (0.1%)	275 (0.1%)
Refused	173 (0.1%)	318 (0.1%)	0 (0%)	2 (0.5%)	0 (0%)	0 (0%)	173 (0.1%)	320 (0.1%)

Table 1 (continued)

	Cisgender women		Gender non-conforming		Transgender Men		Overall	
	Pre-Covid (*N* = 253,796)	During Covid (*N* = 256,766)	Pre-Covid (*N* = 246)	During Covid (*N* = 393)	Pre-Covid (*N* = 450)	During Covid (*N* = 586)	Pre-Covid (*N* = 254,492)	During Covid (*N* = 257,745)
Missing	127,427 (50.2%)	127,403 (49.6%)	128 (52.0%)	248 (63.1%)	213 (47.3%)	399 (68.1%)	127,768 (50.2%)	128,050 (49.7%)
Previous cancer diagnosis								
Breast Cancer	259 (0.1%)	3,195 (1.2%)	0 (0%)	1 (0.3%)	0 (0%)	0 (0%)	259 (0.1%)	3,196 (1.2%)
Cervical Cancer	72 (0.0%)	687 (0.3%)	0 (0%)	0 (0%)	0 (0%)	1 (0.2%)	72 (0.0%)	688 (0.3%)
Other Cancer	734 (0.3%)	9,206 (3.6%)	0 (0%)	10 (2.5%)	3 (0.7%)	10 (1.7%)	737 (0.3%)	9,226 (3.6%)
Missing	252,731 (99.6%)	243,678 (94.9%)	246 (100%)	382 (97.2%)	447 (99.3%)	575 (98.1%)	253,424 (99.6%)	244,635 (94.9%)
Breast Cancer Screening Compliance								
Non-compliant	27,150 (10.7%)	29,165 (11.4%)	21 (8.5%)	14 (3.6%)	46 (10.2%)	48 (8.2%)	27,217 (10.7%)	29,227 (11.3%)
Compliant	74,028 (29.2%)	71,636 (27.9%)	39 (15.9%)	34 (8.7%)	110 (24.4%)	63 (10.8%)	74,177 (29.1%)	71,733 (27.8%)
Don't know	84 (0.0%)	101 (0.0%)	1 (0.4%)	0 (0%)	0 (0%)	0 (0%)	85 (0.0%)	101 (0.0%)
Refused	64 (0.0%)	135 (0.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	64 (0.0%)	135 (0.1%)
Missing	152,470 (60.1%)	155,729 (60.7%)	185 (75.2%)	345 (87.8%)	294 (65.3%)	475 (81.1%)	152,949 (60.1%)	156,549 (60.7%)
Cervical cancer screening compliance								
Non-compliant	2,226 (0.9%)	2,634 (1.0%)	1 (0.4%)	3 (0.8%)	3 (0.7%)	5 (0.9%)	2,230 (0.9%)	2,642 (1.0%)
Compliant	28,998 (11.4%)	29,746 (11.6%)	23 (9.3%)	34 (8.7%)	52 (11.6%)	39 (6.7%)	29,073 (11.4%)	29,819 (11.6%)
Don't know	11 (0.0%)	19 (0.0%)	0 (0%)	0 (0%)	0 (0%)	1 (0.2%)	11 (0.0%)	20 (0.0%)
Refused	0 (0%)	1 (0.0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (0.0%)
Missing	222,561 (87.7%)	224,366 (87.4%)	222 (90.2%)	356 (90.6%)	395 (87.8%)	541 (92.3%)	223,178 (87.7%)	225,263 (87.4%)

[a]American Indian/Alaskan Native

[a]Undefined due to cell size

[a]Undefined due to cell size

Table 2 Adjusted odds ratios and 95% CI for breast and cervical cancer screening compliance

	Cisgender women	Gender non-conforming	Transgender men
Breast cancer screening pre-Covid			
Non-compliant	Ref	1.39 (0.30, 5.00)	1.14 (0.41, 2.75)
Breast cancer screening during Covid			
Non-compliant	Ref	1.75 (0.53, 5.29)	2.39 (1.03, 5.48)
Cervical cancer screening pre-Covid			
Non-compliant	Ref	-[a]	0.84 (0.13, 2.86)
Cervical cancer screening during Covid			
Non-compliant	Ref	0.73 (0.04, 3.74)	2.04 (0.67, 5.15)

Models were adjusted for age, race/ethnicity, and region

Table 3 Adjusted odds ratios and 95% CI for breast and cervical cancer screening compliance, excluding those with breast or cervical cancer diagnosis from their respective analyses

	Cisgender women	Gender non-conforming	Transgender men
Breast cancer screening pre-Covid			
Non-compliant	Ref	1.39 (0.30, 4.99)	1.14 (0.41, 2.74)
Breast cancer screening during Covid			
Non-compliant	Ref	1.73 (0.52, 5.23)	2.37 (1.02, 5.43)
Cervical cancer screening pre-Covid			
Non-compliant	Ref	-[a]	0.84 (0.13, 2.86)
Cervical cancer screening during Covid			
Non-compliant	Ref	0.73 (0.04, 3.74)	2.05 (0.67, 5.15)

Models were adjusted for age, race/ethnicity, and region

Our point estimates suggest that the disparity in breast cancer screening compliance increased during the pandemic. These results are consistent with previous studies showing that TGD patients are less likely to adhere to mammography screening guidelines than cisgender patients [4, 5]. Additionally, these results are consistent with the framework proposed by Zubizarreta et al., highlighting how COVID-19 may disproportionately impact TGD populations [17].

Compared to before the COVID-19 pandemic, during the pandemic a greater proportion of both cisgender women and transgender men were non-compliant with cervical cancer screenings, indicating the impact that the pandemic had on both groups. However, adjusted odds ratios show that during the pandemic, transgender men were more likely to be non-compliant with cervical cancer screening recommendations compared to cis women, potentially pointing to the disproportionate impact of this pandemic on transgender men. These results are consistent with previous studies that found transgender men are less likely to be up-to-date on their Pap tests compared to cisgender women [23]. We observed lower odds of cervical cancer noncompliance before COVID-19 among transgender men, as well as lower odds of cervical cancer noncompliance during COVID-19 among gender non-conforming people which may be explained by other sample characteristics that were not examined in this study, such as health insurance coverage [24].

Differences in the point estimates between transgender men and gender non-conforming respondents have been observed in previous studies [24]. These differences may be explained by variations in provider transphobia [25], gender affirmation, and health insurance coverage [26] between non-binary TGD people compared to binary TGD people. The large confidence intervals suggest that these results should be interpreted cautiously, and may explain some of the inconsistencies observed with previous studies [8, 9]. Unstable estimates are to be expected with small sample sizes, and yet, there are few large studies that gather gender identity data, so this is to be expected until such data are routinely collected.

Due to limited sample sizes, we were only able to calculate adjusted odds ratios for cervical cancer screening compliance comparing gender non-conforming respondents to cisgender women during COVID-19. Our results show that gender non-conforming people are less likely to be non-compliant with cervical cancer screening recommendations than cisgender women. Previous studies have not collected information on gender non-conforming people and population-level estimates on cervical cancer screening compliance are not currently available.

This is one of the first studies to examine the impact of COVID-19 on breast and cervical cancer screening compliance in TGD and cisgender individuals across the U.S. Delayed care can lead to poorer health outcomes [27]. If cancer is detected later, it could mean that patients are diagnosed at more severe stages and have lower chances of survival.

Limitations

BRFFS data can be made more representative of the U.S. population via data weighting, however, this process relies on the existing sex variable, which may misclassify participants, especially TGD participants [22]. Since this study does not rely on the weighting system, the study sample can be thought of more as a convenience sample, and therefore may not be a representative sample. For the 2018, 2019, 2020, and 2021 surveys, BRFFS asks participants 'Are you male or female?' and interviews are terminated with participants who refuse to answer or report "don't know/not sure" [28]. TGD participants may have been less likely to answer this resulting in non-response bias, or they may have answered based on their gender, resulting in misclassification.

Questions regarding breast cancer, cervical cancer, and hysterectomies are only asked to participants who report being 'female' which may have resulted in biased estimates by excluding or including certain participants. In the future, we recommend that BRFSS utilize a two-step [29] item to assess sex assigned at birth and gender identity for all participants. Questions regarding gender-affirming surgeries and hormone therapy are not asked in these versions of BRFFS, which could impact screening recommendations, and therefore compliance [2].

Because of the aggregated ages reported in the publicly available version of the data and the small counts, it is impossible to assess cervical cancer screening compliance for individuals 21–24 years old, despite screening being recommended for this age group. The reported cancer diagnosis relies on the most recently reported diagnosis of cancer. If participants have had breast or cervical cancer, but have been diagnosed with another cancer more recently, the survey would not capture that information, causing misclassification.

Future work and recommendations

Although, it is an important first step to catalog the compliance across different gender identities, future research should focus on explanatory factors for the differences observed between breast and cervical cancer screening across gender identity. Gaining a better understanding of why differences exist will allow for tailored interventions. Recent work suggests that access to a trans-competent healthcare provider can reduce barriers to routine and satisfactory cancer screenings [30]. Additionally, health centers and providers who explicitly advertise trans-inclusive screenings [31] ask

preferred names, pronouns, and anatomical terms [32], and offer self-collected swabs for HPV [33] are often preferred by TGD patients. Improving provider education will ensure that providers recommend or offer the appropriate routine screenings to their TGD patients [34]. More work is needed to understand how biological, social, and structural determinants impact the risk of these cancers in TGD populations to develop trans-specific, evidence-based screening guidelines, rather than assuming recommendations designed for cisgender patients apply to TGD patients [35]. Additional work should continue to dismantle systems of oppression, including transphobia, that are a major contributor to health disparities.

Conclusions

Differences in breast and cervical cancer screening compliance exist across gender identity and were impacted by COVID-19, with almost all groups experiencing decreases in screening compliance. TGD respondents were more likely to be non-compliant with breast cancer screening recommendations, potentially explained by unique barriers to care, discrimination, and transphobia in healthcare. Future work should move beyond descriptive statistics and seek to examine causes of screening compliance differences across gender identity, to motivate useful interventions.

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Data availability The datasets generated and analyzed during the current study are available from the CDC BRFSS Survey Data from 2018, 2019, 2020, and 2021. Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Survey Data*. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, [2018–2021].

Declarations

Competing interests The authors have no relevant financial or non-financial interests to disclose.

Ethical approval The Harvard Longwood Campus IRB determined that this study does not meet the requirements of human subjects' research, therefore the need for IRB approval was waived.

Informed consent Informed consent was not applicable to this study because it is based on publicly available data from the Centers for Disease Control and Prevention (CDC).

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