Family Medicine and Community Health

The 2020 US cancer screening deficit and the timing of adults' most recent screen: a population-based cross-sectional study

Jason Semprini [1], Radhika Ranganathan [2]

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[1]Health Management & Policy, The University of Iowa College of Public Health, Iowa City, Iowa, USA
[2]Epidemiology/Biostatistics, University of South Carolina Arnold School of Public Health, Columbia, South Carolina, USA

Correspondence to
Dr. Jason Semprini;
jason-semprini@uiowa.edu

ABSTRACT

Objective In 2020, cancer screenings declined, resulting in a cancer screening deficit. The significance of this deficit, however, has yet to be quantified from a population health perspective. Our study addresses this evidence gap by examining how the pandemic changed the timing of American adults' most recent cancer screen.

Methodology We obtained population-based, cancer screening data from the Behavioural Risk Factor Surveillance System (BRFSS) (2010, 2012, 2014, 2016, 2018, 2020). Mammograms, pap smears and colonoscopies were each specified as a variable of mutually exclusive categories to indicate the timing since the most recent screening (never, 0–1 years, 1–2 years, 3+ years). Our cross-sectional, quasi-experimental design restricts the sample to adults surveyed in January, February or March. We then leverage a quirk in the BRFSS implementation and consider adults surveyed in the second year of the 2020 survey wave as exposed to the COVID-19 pandemic. Respondents surveyed in January 2020–March 2020 were considered unexposed. To estimate the impact of exposure to the COVID-19 pandemic on the timing of recent cancer screenings, we constructed linear and logistic regression models which control for sociodemographic characteristics associated with screening patterns, and state fixed effects and temporal trend fixed effects to control for confounding.

Results In 2020, the cancer screening deficit was largely due to a 1 year delay among adults who receive annual screening, as the proportion of adults reporting a cancer screen in the past year declined by a nearly identical proportion of adults reporting their most recent cancer screen 1–2 years ago (3%–4% points). However, the relative change was higher for mammograms and pap smears (17%) than colonoscopies (4%). We also found some evidence that the proportion of women reporting never having completed a mammogram declined in 2020, but the mechanisms for this finding should be further explored with the release of future data.

Conclusion Our estimates for the pandemic's effect on cancer screening rates are smaller than prior studies. Because we account for temporal trends, we believe prior studies overestimated the effect of the pandemic and underestimated the overall downward trend in cancer screenings across the country leading up to 2020.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The COVID-19 pandemic created a cancer screening deficient in 2020; however, prior research aiming to quantify the magnitude of this deficit may not have adequately accounted for pretemporal trends in cancer screening.

WHAT THIS STUDY ADDS

⇒ The pandemic was associated with 1-year delays in cancer screening, but our findings suggest that the impact of COVID-19 on the cancer screening deficit in 2020 was smaller than initial projections and existing evidence. Moreover, we find some evidence that mammogram initiation rates may have increased in 2020.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Providers and public health professionals implementing 'return to screening' initiatives should consider pre-COVID-19 trends in screening and consider specifically targeting adults who have delayed cancer screening due to factors unrelated to the pandemic. Future researchers should investigate the mechanisms to help explain why mammography initiation rates increased in 2020 relative to prior years. Future COVID-19 services research could improve internal validity by incorporating valid, yet intuitive quasi-experimental designs.

BACKGROUND

Despite the importance of early cancer detection, screening rates in America are well below public policy targets.[1–3] Even before the first wave of the COVID-19 pandemic in March 2020, predictions for cancer prevention and control systems were dire. Given the elevated risk to patients with cancer, either from adverse COVID-19 outcomes or consequences of delayed cancer treatment, health systems needed to adapt to ensure the safety of patients with cancer during these initial months.[4–6] These risk mitigation and continuity of care policies may have prevented dramatic declines in the proportion of patients with cancer receiving care.[7 8] Unfortunately, cancer screening was less of a priority during the early months of the public health emergency.[9]

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Cancer screening could have been impacted by a number of federal, state or local public health emergency policies, as well as by the changing priorities and capacities of health systems, and by individual social distancing behaviours.[9–11] More recent research illuminated the role of financial stress and time costs as individual-level barriers to cancer screening, both of which may have compounded the strain on health systems attempting to resume cancer screening.[12–14]

There has been no shortage of evidence highlighting the stark decline in cancer screening services during the initial stages of the pandemic. Evidence from hospital records or insurance claims has suggested that, compared with prepandemic levels, mammograms, pap smears and colonoscopies declined 60%–90% in March/April 2020.[15–17] However, subsequent research has found that in the later months of 2020, claims and records of cancer screenings returned to prepandemic levels.[18–23] Still, the pandemic created a major cancer screening deficit which may be difficult to address despite recent investment in 'return to screening' initiatives.[12 18 24] Even as America returns to screening, some are being left behind.[25] In fact, among the adults reporting having delayed cancer screenings during the 2020 pandemic year only 25% have plans to return to screening.[1]

The COVID-19 pandemic created a cancer screening deficit in 2020; however, our understanding of this deficit is limited to hospital and claims-based data, which is not necessarily a valid representation of the population's screening behaviour. Moreover, the limited population-based research has attempted to quantify changing patterns in cancer screening by comparing rates in 2020 with 2019, or an average of prior years, essentially assuming that any change observed in 2020 was due to the pandemic.[26–28] This assumption, however, may not be valid as several factors could impact temporal screening patterns.[7] Finally, few studies have attempted to infer the significance of this decline or deficit in cancer screenings in terms of how the time since the most recent cancer screen may have changed.[26 29] This is critical for 'return to screening' initiatives, as targeting or prioritising health system capacity should consider the pandemic's effect on the timing of a cancer screen; not just for adults who delayed care for a year, but for adults who delayed for longer or even delayed initiating their first cancer screen.

Our study addresses these evidence gaps by designing a population-based quasi-experimental Event History Analysis, where we compare the year-by-year change in the timing of the most recent cancer screen among adults not exposed to the 2020 pandemic with the change in adults exposed to a full year of the pandemic. This approach allows us to control for temporal trends in screening patterns and estimate the effect of the pandemic on cancer screening patterns amidst declining and stagnating screening patterns before 2020.

METHODS AND MATERIALS

Data sources

We analysed data from the Behavioural Risk Factor Surveillance System (BRFSS), a cross-sectional random-digit-dialled, telephonic survey (both landline and cellphone), performed by the Centers for Disease Control and Prevention, of nationally representative sample involving non-institutionalised civilian population, aged 18 years or older, who reside in the USA.[30] This population based self-reported, ongoing survey is conducted across all 50 states, Washington, DC and three US territories, which collects information on behavioural health risks, chronic conditions and the usage of preventive services covering more than 400 000 adult interviews each wave year. For each annual survey, BRFSS interviews participants from 1 January of the survey year to 30 March of the following year. The primary variables of interest are three cancer screening questions available in the BRFSS data (mammograms, pap smears and colonoscopies).

Sample

The eligibility criteria of our study first included non-institutionalised adults 18 years or older, residing in the US (including Washington, DC), interviewed between 1 January and 31 March in the BRFSS cancer modules (2010, 2012, 2014, 2016, 2018, 2020). We further restricted inclusion based on BRFSS cancer module eligibility, where we restricted the sample to adults who were asked whether they have received a mammogram, pap smear and/or sigmoidoscopy/colonoscopy screening services.[30] Note, we did not include BRFSS variables on lung cancer screening or HPV testing as these data were not available for all even years 2010–2020.[30] We also excluded blood stool tests, as the BRFSS language changed between 2018 and 2020 survey.[30] We then used respondent's self-reported age to restrict our analysis to adults eligible for each respective cancer screen based on the United States Preventative Task Force age recommendations: mammograms (females age 40–74), pap smears (females age 25–64) and colon/sigmoidoscopies (males and females age 45–79).[31–33] Participants from unknown US territories/jurisdictions, those who were interviewed between 1 April and 31 December for the years 2010–2020, those interviewed in the years which did not use cancer modules (odd year survey waves), were all excluded (online supplemental figure 1).

Variables

This study has three categorical outcome variables, all based on self-reports during the BRFSS interview: timing of the most recent mammogram; timing of the most recent pap smear; and timing of the most recent colonoscopy/sigmoidoscopy.[30] Each variable was coded as <1 year, within the past 1–2 years, 3+ years or never. In addition to controlling for state and year fixed-effects, our analyses include variables to adjust for socioeconomic factors which could be associated with cancer screening patterns. These socioeconomic factors, which are based

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on self-reported data provided during the BRFSS interview, include age, race, ethnicity, education level, marital status, sex.[30] The control variables are modelled as binary dummy variables by creating mutually exclusive groups for each factor: age (5 years age groups), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic and non-Hispanic other), education status (no high school, high school degree only or General Education Development (GED), some college but no 4 years degree, 4 years college degree only or at least some graduate-level education and/or degree), whether the respondent is married, and whether the respondent is male. A group considered exposed to the COVID-19 pandemic if they were interviewed after March 2020. Respondents with missing outcome data were dropped from the analysis.

Study design and setting

From the perspective of the analyst, the ideal experiment to evaluate how the COVID-19 pandemic impacted cancer screening would be to randomly assign adults into two groups: those exposed and those not exposed to the pandemic. After tracking individual screening behaviour over time, any difference observed during the pandemic year (2020) would be attributed to the COVID-19 pandemic. This design is comically unrealistic. Unfortunately, quasi-experimental designs using 'as-if' randomisation into treatment and controls are also infeasible. Because the COVID-19 pandemic was a global event, everyone was exposed and everyone was impacted. Simple pre/post analyses have attempted to measure the change in cancer screening rates, but these approaches fail to account for other temporal factors which could be influencing screening rates in ways unrelated to the pandemic.

Rather than attempt to create different groups based on exposure to the pandemic during the pandemic year, we take a different approach by leveraging how BRFSS implements each of its cross-sectional surveys over the course of 15 months (ie, 1 January 2020–31 March 2021). Selection into the BRFSS sample is random, but so is the timing of the interview. Each respondent selected into the BRFSS sample is then randomly allocated to an interview date. Therefore, there is no reason to expect any systematic differences in cancer screening behaviour between adults queried early in a single year BRFSS survey wave and adults queried later in that same BRFSS survey wave; except however, during the COVID-19 pandemic year.

Our design begins by creating two distinct quasi-groups of adult BRFSS respondents. The first group only includes adults surveyed between 1 January and 31 March of the first year in each survey wave. We consider this 'early' group the control group. Our second group only includes adults surveyed between 1 January and 31 March of the second year in each survey wave. We consider this 'late' group the treatment group. Online supplemental table 2 reports the cancer screening rates for both quasi-treatment and control groups for years 2010–2018. We test for significant differences in proportions between both groups and report the t-statistic and respective p value to assess the comparability of these groups prior to 2020. We also conduct similar proportion tests for the sample composition of our control variables.

Prior to 2020, we hypothesise that screening behaviour is not significantly different between our control and treatment groups. We also hypothesise that, prior to 2020, the trends in screening behaviour do not differentially vary by group (see statistical analysis section below for details on these identification tests). Evidence that levels and trends did not vary between groups prior to 2020 supports our identification assumption: that any difference in screening rates observed in 2020 should be attributed to the COVID-19 pandemic.

Statistical analysis

For each of the three cancer screenings (mammograms, pap smears and colonoscopies), we model the probability of self-reported cancer screening behaviour as mutually exclusive categories related to the timing of the most recent screen. This approach not only allows us to model the change in probabilities over time, but also model how the distribution of cancer screening behaviour changes between each timing category. Our initial specification models the probability of a recent cancer screen as a series of linear probability models.

To account for confounding from secular trends in cancer screening, each model includes a vector of binary fixed-effects variables indicating the survey wave year. These survey wave fixed effects account for temporal trends in cancer screening. Additionally, to account for time-invariant, regional behaviours, policies and health systems confounding cancer screening, each model includes a vector of binary fixed-effects variables indicating the state of residence for each respondent.

We then estimate the incremental effect of the COVID-19 pandemic on screening behaviour. Rather than implement a simple pre/post design, we explicitly allow the screening behaviour in the treatment group to vary from the screening behaviour in the control group for each year of the analysis.[34] The event history approach estimates the average association between cancer screening behaviour for adults surveyed in the later part of each BRFSS survey wave. This approach also allows us to test if the change in screening rates prior to the pandemic was equal to the change in screening rates after the pandemic.[35] More importantly, we can now visually assess and empirically test our identification assumptions.[36] Following best practice, we formally conduct pretreatment differential trend tests by excluding responses in the 2020 survey wave and then recompute the analysis.[37] In addition to reporting each year's group coefficient, we calculate robust Wald statistics (with Bonferroni correction) to test if the trends in cancer screening rates between quasi-treatment and control groups jointly equalled zero.[38] Any significant results from these pretreatment tests would suggest that cancer screening behaviours were differentially changing for exposed, compared with control groups, in ways

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unrelated to the COVID-19 pandemic. Conversely, null results provide confidence in the strength of our identifying assumption and supports the validity of our study design.

All analyses incorporate BRFSS supplied sampling weights, estimate standard errors robust to heteroskedasticity and cluster the robust SEs at the state level, with alpha = 0.05 for significance.[39 40] The Bonferroni correction method was used to adjust for multiple hypothesis testing for group differences and pretreatment joint Wald tests.[38]

Alternative specifications

To ensure that our results are not sensitive to our linear probability model specification, we construct an alternative specification to model the probability of a recent cancer diagnosis with a multinomial logistic regression model. After comparing the predicted probabilities of these non-linear models with the predictions of our linear model, we use the coefficients in the nonlinear models to estimate the average incremental effect of the exposed group (compared with the control group) in each year on the probability of each cancer outcome.[41] We then test if the point estimates and SEs in our linear models are significantly different from the estimates in the non-linear specifications. We also estimate the semi-elasticity, or relative change from baseline screening rates, for the treatment group in 2020.[41] A final set of sensitivity analyses relax the model assumptions by (1) removing the state-specific fixed effects, (2) remove state-specific fixed effects and estimate (unclustered) robust SEs, (3) remove state-fixed effects, estimate (unclustered) robust SEs and ignore probability sampling weights.

Patient and public involvement

No patient or public involvement.

RESULTS

The final analytical sample included 662 867 adults (online supplemental figure 1). The sample included 238 848 female respondents between ages 40 and 74 who were asked about mammography screening patterns and 224 061 female respondents between ages 26 and 64 who were asked about pap smear screening patterns. For colon/sigmoidoscopy questions, the sample included 418 526 males and females between ages 45 and 79. Prior to 2020, the early and late survey wave groups reported similar cancer screenings in the past year and were composed of similar socioeconomic compositions (table 1). Online supplemental tables 2–4 visualise the timing of a most recent cancer screening for mammograms, pap smears and colon/sigmoidoscopies.

Event-history estimates (linear model)

In short, we find evidence that in 2020, exposure to the COVID-19 pandemic was associated with changing patterns of self-reported cancer screenings. Our estimates in table 2 reveal that, for the quasi-treatment group (late survey wave) in 2020, reports of a cancer screen in the past year declined as reports of a most recent cancer in the past 1–2 years increased. In 2020 for the quasi-treatment group, we also estimate a significant decline in self-reports of never having had a mammogram, which corresponds to a 33% relative decline from baseline rates of women reporting never having completed a mammogram. The absolute change for reporting a most recent mammogram in the past 1–2 years increased 3.1% points (95% CI 0.1 to 6.1), which corresponds to a 17.5% increase from prepandemic rates of having reported a recent mammogram in 1–2 years. Similarly, the absolute change for reporting a most recent pap smear in the past 1–2 years increased 4.2% points (95% CI 0.4 to 8.0), representing a 17.3% relative increase from prepandemic rates. Finally, reports of a colonoscopy in the past year were estimated to have declined by 3.5% points (95% CI −0.3 to −6.7), a 4.3% relative change from baseline.

Marginal effect estimates (logistic model)

Figures 1–3 visually report the non-linear, average marginal effect estimates (derived from the results of the multinomial logistic model). Here, for each screening type and category, the average marginal effect of belonging to the quasi-treatment group for each year of the analysis. For our 2020 year of interest, we estimate average marginal effects significantly different than zero for mammograms in the past 1–2 years, pap smears in the past 1–2 years and colonoscopies in the past year. However, we also see years when the average marginal effect of belonging to the quasi-treatment group was significantly different than zero in prepandemic years.

Alternative specifications

Our effect estimates and inference do not appear sensitive to linear or non-linear model specification. Online supplemental table 1 shows the 2020*late effect estimates for the linear probability model specification and the multinomial logistic model specification. For each type of screening and screening category, none of the estimates are significantly different from each other. The major takeaway from online supplemental table 1 that the effect estimates in the non-linear model were more precise (smaller SEs) for significant estimates for mammograms and colonoscopies.

Now while the estimates do not change with regard to including state-fixed effects, clustering robust SEs and weighting our analyses, our inference would change depending on the preferred specification. Online supplemental table 2 shows the alternative designs (Alt 1—no state fixed effects, Alt 2—no state fixed effects, no clustering robust standard errors, Alt 3—no state fixed effects, no clustering robust SEs, and no probability sampling weights). However, the increased

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Table 1 Summary statistics (mean proportions) of analytical sample

	2010–2018		2020	
	Early	Late	Early	Late
Mammogram <1 year	0.400	0.379	0.470	0.414
Pap smear <1 year	0.467	0.420	0.304	0.289
Colon/sigmoidoscopy <1 year	0.211	0.195	0.144	0.116
Missing any cancer screening responses	0.014	0.035	0.027	0.062
Age 18–24	0.126	0.134	0.059	0.073
Age 25–29	0.081	0.091	0.048	0.057
Age 30–34	0.094	0.103	0.057	0.063
Age 35–39	0.081	0.088	0.060	0.065
Age 40–44	0.089	0.088	0.060	0.067
Age 45–49	0.080	0.077	0.063	0.065
Age 50–54	0.097	0.094	0.076	0.078
Age 55–59	0.081	0.081	0.091	0.089
Age 60–64	0.080	0.077	0.106	0.096
Age 65–69	0.061	0.059	0.111	0.105
Age 70–74	0.048	0.043	0.103	0.099
Age 75–79	0.038	0.030	0.075	0.062
Age 80–84	0.043	0.034	0.091	0.080
Non-Hispanic white	0.659	0.581	0.772	0.736
Non-Hispanic black	0.114	0.106	0.070	0.098
Non-Hispanic other race/ethnicity	0.074	0.100	0.068	0.059
Hispanic	0.136	0.197	0.068	0.086
No primary education	0.002	0.003	0.001	0.002
Primary education only	0.041	0.053	0.020	0.024
Some high school education, no degree	0.092	0.093	0.046	0.047
High school degree only	0.285	0.270	0.273	0.275
Some college education, no bachelor's degree	0.305	0.308	0.283	0.288
Bachelor's degree or more	0.274	0.273	0.378	0.364
Married	0.524	0.515	0.522	0.521
Divorced	0.105	0.101	0.134	0.127
Widowed	0.066	0.059	0.122	0.108
Separated	0.024	0.024	0.019	0.020
Never married	0.237	0.251	0.168	0.186
Unmarried partner	0.044	0.050	0.035	0.038
Male	0.421	0.447	0.459	0.462
Total N	557 304	49 256	50 325	5982

Reports the summary statistics of the primary outcome variable (a most recent cancer screening within 1 year), proportion of the sample missing any cancer responses, socioeconomic control variables and sample size for each group (early and late survey wave) and year (before 2020 and during 2020).

number of significant pretrend test statistics when excluding state fixed effects for both types of screenings warrants inclusion of the state-fixed effects to account for differential, time-invariant screening rates between quasi-treatment groups. Moreover, failing to account for clustering and weighting within each state may also add noise to our inference. Compared with our primary specification, our sensitivity analyses result in more differential pretrend tests where we reject the null hypothesis (of no differential trends). Thus, we conclude that our primary specification is the most internally valid design.

Assessing internal validity

Comparability of quasi-treatment groups

On observing the unadjusted reports of a most recent cancer screen prior to 2020, we find little convincing evidence to believe that screening rates in the two

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Table 2 Year-by-year differences in screening rates for late survey group

		2010*late	2012*late	2014*late	2016*late	2020*late	2020 relative change
Mammogram	Never	−0.006	0.009	−0.013	−0.017	−0.029*	−33.0%
	<1 year	−0.011	−0.030	0.004	0.020	−0.021	−3.5%
	1–2 years	−0.008	0.003	0.002	−0.000	0.031*	17.5%
	3+ years	0.025	0.018	0.007	0.002	0.020	11.5%
Pap smear	Never	0.017	−0.011	−0.024*	−0.009	−0.011	−22.2%
	<1 year	0.019	0.015	0.046*	−0.007	−0.043	−13.5%
	1–2 years	−0.008	−0.014	0.003	0.024	0.042*	17.3%
	3+ years	-0.028	0.010	-0.026	0.008	0.012	10.2%
Colonoscopy	Never	0.025	0.045*	0.042	−0.011	−0.010	−1.06
	<1 year	−0.032	−0.012	−0.031	0.013	−0.035*	−4.3%
	1–2 years	0.016	−0.035	0.011	−0.009	0.030	3.8%
	3+ years	-0.009	0.002	0.023	0.008	0.015	2.1%

Reports the year-by-year differences in cancer screening rates between the early and late survey groups. All analyses control for exogenous sociodemographic characteristics, state-level fixed effects and temporal trends (year fixed effects). Inferences is based on robust SEs clustered at the state level (not reported). See online supplemental table 6 for reported SE estimates. The relative change was estimated by computing the semielasticity (relative marginal effect) of belonging to the late survey group in 2020.
*p<0.05.

groups differed before the first pandemic year. Online supplemental figures 2–4 visually depict the unadjusted cancer screening rates for our quasi-treatment (late survey wave) and quasi-control (early survey wave), for each year in our analyses. For each category of mammograms and pap smears, we see nearly identical trends and levels in the most recent screening from 2010 to 2018. For adults reporting never having completed a colonoscopy and adults reporting a colonoscopy in the past year, we do see some possible non-common levels from 2010 to 14, but the trends and levels appear similar from 2016 to 2018.

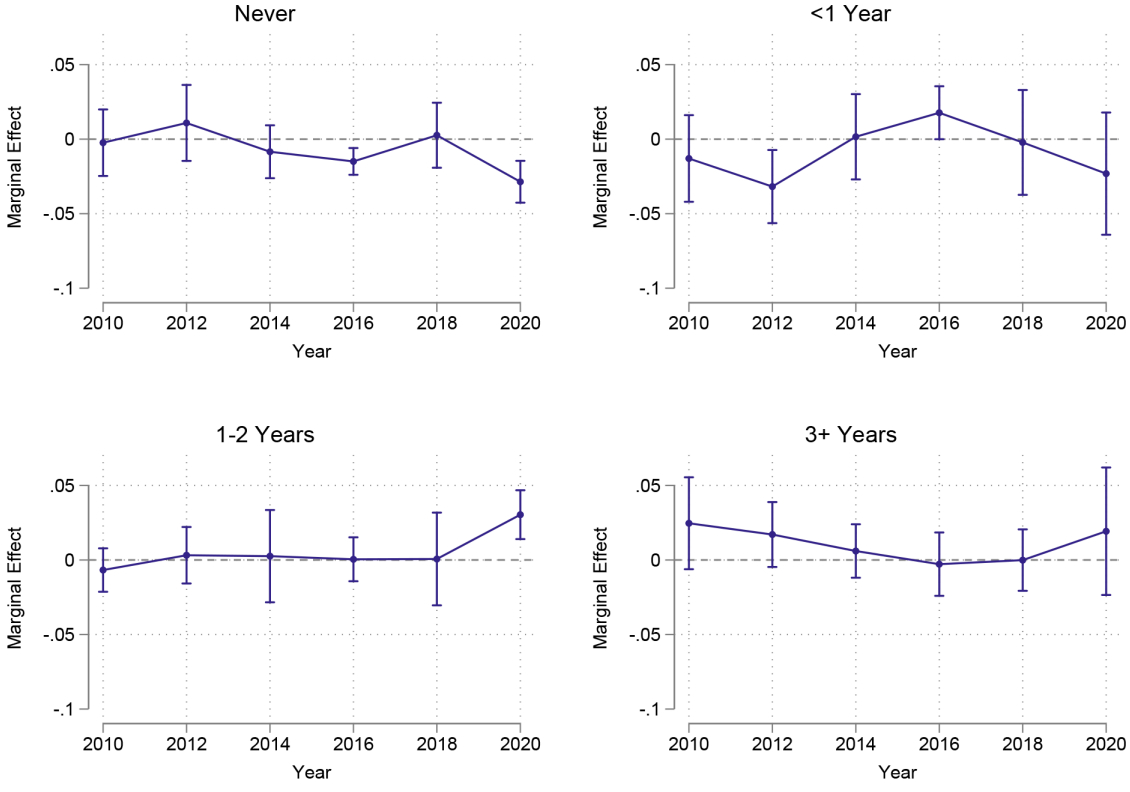

Figure 1 Marginal effect estimates for each category of the most recent self-reported mammograms for the late-survey wave cohort. These estimates were based on the results of the multinomial logistic model and were averaged across all observations.

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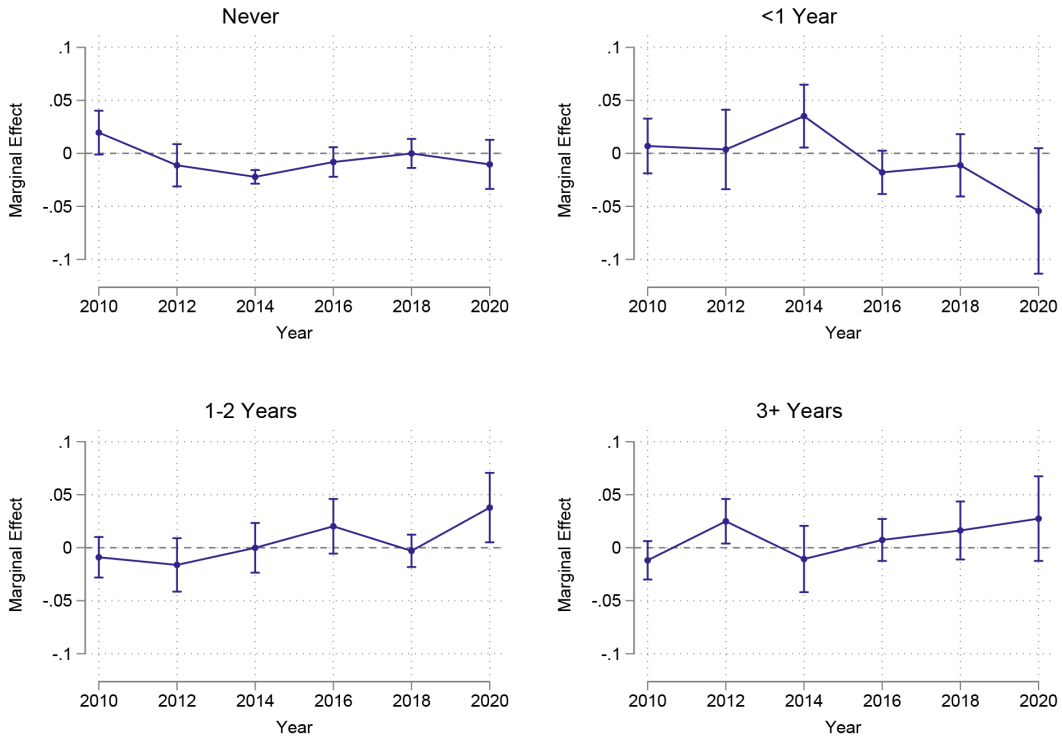

Figure 2 Marginal effect estimates for each category of the most recent self-reported pap smears for the late-survey wave cohort. These estimates were based on the results of the multinomial logistic model and were averaged across all observations.

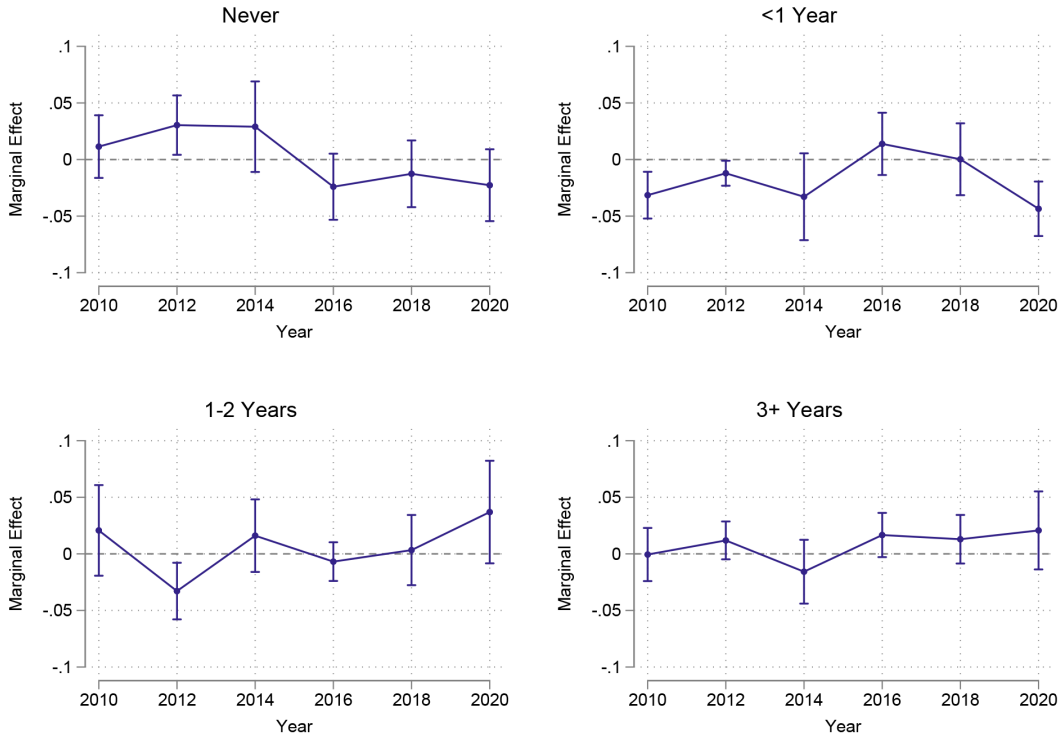

Figure 3 Marginal effect estimates for each category of the most recent self-reported colonoscopies for the late-survey wave cohort. These estimates were based on the results of the multinomial logistic model and were averaged across all observations.

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The results of our two-sample proportion tests further validate our assumption that these two quasi-treatment groups had similar baseline screening rates. Note that online supplemental table 3 does report a few screening outcomes with p values under 0.05, but these test statistics are not significantly different than zero after accounting for multiple hypothesis testing (significance threshold p<0.0125). Further, we fail to reject the null hypothesis that the sample composition of these two quasi-treatment groups are significantly different from each other along socioeconomic factors (online supplemental table 4).

Differential pretrend tests

To assess our design's internal validity, we empirically tested for differential trends between early and late groups prior to 2020. Online supplemental table 5 reports the year-by-year effect estimates (absolute differences) between quasi-treatment groups after excluding year 2020 from the analysis. We find no statistically significant differences between early and late groups in pre-2020 effect estimates for mammograms.

We do, however, detect the potential for differential trends in pap smears, specifically for adults reporting never having completed a pap smear and having completed a pap smear in the past year. The source of the potential pretrend differences are observed in 2014. For both categories, we reject the null hypothesis that pap smear screening trends were similar prior to 2020 (p<0.0125).

Additionally, we detect the presence of differential trends for adults reporting their most recent colon/sigmoidoscopy three or more years prior. Again, the source of the differential pretrend is observed in 2014. We reject the null hypothesis that, prior to 2020, reports of a colon/sigmoidoscopy three or more years ago were similar between the two quasi-treatment groups (p<0.0125).

DISCUSSION

The results above suggest that, because of the COVID-19 pandemic, women were more likely to delay their mammogram and pap smear. We also found that fewer adults completed their colonoscopy in the past year. However, our point estimates are smaller than the most recent population-based research.[26] We attribute this difference to the fact that our study includes adults exposed, not just to the entire pandemic year, but to the 'rebound period'. Additionally, our event-history design attempts to control for temporal changes which could be affecting cancer screening rates in ways unrelated to the pandemic, which other studies may fail to identify with simple pre/post designs.

The dire predictions and early evidence that cancer screening dramatically declined prompted investment and capacity for 'return to screening' initiatives and patient prioritisation policies.[42 43] However, most early predictions focused on the initial decline, as opposed to the subsequent rebound, and so did most of the early research. Even the research which accounted for the rebound, failed to account for other, non-pandemic factors which could be biasing the cancer screening deficit estimate.

The implications of our findings suggest that 'return to screening' initiatives and prioritisation policies based on the overestimated effects of the pandemic on screening, may fail to achieve greater screening adherence.[44–46] This is especially true for adults who have been delaying recommended cancer screenings for three or more years, delays which started before the pandemic year. To advance cancer equity, future research must continue monitoring the post-2020 cancer screening rebound to assess who is still delaying cancer screenings and how effective programmes are mitigating these long-term delays.

Finally, our results not only signal delayed cancer screening in 2020, but increased initiation. The proportion of women reporting to have never completed a mammogram declined for our late group in 2020 (relative to the change in the early group). Did the 'return to screening' policies navigate new patients to their first mammogram? Or, was this decline merely a result of a 'lower population denominator' after a year of elevated excess mortality? Future data can help us understand the mechanisms influencing the post-COVID-19 screening rebound, which will be critical for advancing efforts to improve early cancer detection in America well beyond this pandemic.

Limitations

This study acknowledges several limitations inherent in the utilisation of the dataset to investigate cancer screening behaviours. First, reliance on self-reported data raises concerns regarding its accuracy and reliability, as it is subject to recall bias and individual interpretation. Participants' memory, perception and willingness to disclose sensitive health information accurately may introduce measurement errors and under-reporting of cancer screening practices. Second, the BRFSS data lacks granularity in terms of the exact timing of screenings, impeding a comprehensive assessment of adherence to recommended screening intervals. Moreover, the cohort approach employed in this study limits the ability to evaluate subgroup differences due to a smaller sample size in the late cohort, potentially compromising the statistical power needed for robust subgroup analyses. Next, the absence of relevant data on financial stress or other pandemic-related stressors hampers a comprehensive understanding of how these factors influence decisions to seek cancer screening. Finally, although the study was designed to maximise internal validity, the retrospective and cross-sectional nature of our data warrants caution when interpreting these estimates as causal. These limitations should be taken into consideration when interpreting the study findings, emphasising the need for future research to identify valid mechanisms explaining the relationship between exposure to the pandemic and

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delayed cancer screening and to enhance the generalisability of the findings by assessing if certain subgroup or geographic populations were more impacted than others.

CONCLUSION

The COVID-19 pandemic disrupted the healthcare system, leading to delays in necessary preventative care. Access to screening services is expected to dramatically decline in 2020. Consistent with prior research, we found that adults delayed cancer screenings. This cancer screening deficit was largely due to a 1-year delay among adults who receive annual screening, as the proportion of adults reporting a cancer screen in the past year declined by a nearly identical proportion of adults reporting their most recent cancer screen 1–2 years ago. While the absolute changes were similar between three common cancer screenings (mammograms, pap smears and colon/sigmoidoscopies), the relative change was highest for mammograms and pap smears. However, our unique study design and analytical approach allowed us to control for stagnate and downward trends in cancer screening patterns. By accounting for temporal trends, we believe prior work evaluating the impact of COVID-19 on preventative services overestimated the effect of the pandemic and underestimated the overall downward trend in cancer screenings leading up to 2020. Future research should continue monitoring and evaluating cancer screening trends to both ensure the efficacy of 'return to screening' initiatives and reverse the downward and stagnating trends in cancer screening.

Twitter Radhika Ranganathan @RadhikaRangana5

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ORCID iDs

Jason Semprini http://orcid.org/0000-0002-0375-8090

Radhika Ranganathan http://orcid.org/0000-0002-8443-373X

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