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A pharmacist-led community-based survey study: Determining the impact of the Covid-19 pandemic on actionable factors associated with worse cancer outcomes and cancer health disparities

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ABSTRACT

Purpose: The goals of this cross-sectional community-based survey study were to assess the impact of the Covid-19 pandemic on actionable factors which are known to contribute to worse cancer outcomes, and to determine whether race and ethnicity-based differences exist.

Methods: A survey study which captured demographic information and changes in cancer outcomes-related factors since the start of the Covid-19 pandemic, was conducted at a public Covid-19 vaccination clinic over a period of 10 days during March 2021. Surveys were administered in multiple languages. Chi-square tests and ANOVA followed by post-hoc Dunnett testing assessed for race and ethnicity-based differences.

Results: A total of 949 people participated (61.6% participation rate). Ninety-three surveys were removed based on inclusion criteria giving a final participant number of 856. Many participants reported postponing cancer screenings (17.8%) and cancellation of medical appointments (22.8% and 25.8% reported cancelled appointments by providers or themselves, respectively) due to the pandemic. Participants also reported decreased physical activity (44.7%) and increased tobacco and/or marijuana usage (7.0%). Conversely, participants reported consuming more fruits and vegetables (21.4%) and decreasing alcohol consumption (21.4%). Several race-related differences but no ethnicity-related differences were observed.

Conclusion: Our data can be used to help guide pharmacist-led targeted outreach in our community which will help mitigate Covid-19 pandemic-driven changes in behaviors associated with worse cancer outcomes and exacerbation of cancer health disparities. To our knowledge, this is the first cancer outcomes-related study to be conducted at a public Covid-19 vaccination site and is the first pharmacist-led study in this area.

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1. Introduction

There are multiple factors which are known to be associated with worse cancer outcomes and many of these are actionable, i.e. it is possible to put measures in place to help mitigate them.[1,2] For example, it is well known that there is a strong association between cancer screening rates and cancer outcomes[3–5] and that tobacco usage increases overall cancer risk.[6–8] Tobacco usage is the number one actionable factor associated with cancer deaths and it has been associated with worse outcomes for oral, lung, liver, stomach, kidney, bladder, colorectal, uterine, pancreatic cancers.[9] Decreased physical exercise, increased alcohol consumption, and poor diet have also been widely recognized as actionable factors which are associated with several cancer types.[10–13] Many of these factors have been shown to be more prevalent in minority populations and this can contribute to cancer health disparities.[14] For example, it has been reported that prevalence of physical inactivity outside of work is highest in Asian adults.[15] Resulting disparities are reflected by differences in the following common measures of cancer outcomes within minority communities: cancer incidence, prevalence, stage at diagnosis, mortality, survival, morbidity, survivorship and quality of life after cancer treatment, financial burden.[16]

Data from several national studies indicates that the Covid-19 pandemic may have negatively impacted factors which contribute to worse cancer outcomes and that this negative impact may have been greater in minority populations.[17–25] However, there is a lack of community-based studies which have looked at contributing factors. Community-based studies are important because data from these can help support and inform subsequent community-based outreach efforts which can be targeted to specific populations. Providing effective outreach and education are essential components of any wellness program and have been shown to be successful in helping reduce cancer morbidity and mortality rates.[26,27] For example, smoking cessation programs have helped support an over 70% reduction in cigarette smoking since 1965.[28]

Pharmacists are well positioned to play an important role in community outreach efforts based on their training, experience, and penetrance and accessibility in all communities and there are several examples of successful outreach studies involving pharmacists.[27,29–35] Pharmacists already play a key role in helping mitigate worse cancer outcomes by providing smoking cessation counseling and dispensing smoking cessation medications, and studies have shown this has been effective in reducing smoking rates [30–32]. All licensed pharmacists can provide education and help patients choose from over-the-counter nicotine replacement therapy options available for smoking cessation. In many states, including California, pharmacists with advanced training and working under a collaborative practice agreement or state protocol can authorize prescription medications for smoking cessation. Similarly, pharmacists with advanced training can also authorize prescription medications for alcohol cessation. Pharmacists also have training in motivational interviewing which can be utilized to encourage healthier habits through behavior change.[36] It is important for pharmacists to have this training and these skillsets because based on their accessibility and penetrance within communities they often serve as the initial healthcare professional to community members to recognize signs of early cancer and/or cancer risk factors. This is particularly true within underserved communities where many minority populations live. The potential exists for pharmacists to serve a bigger role in cancer control through extending counseling services relating to other actionable factors and this is supported by several studies and opinion pieces.[37–39] An expanded role in this area also aligns with the Surgeon General's 2018 call to action relating to community health and prosperity.[40]

The primary goals of the current study were to determine the impact of the Covid-19 pandemic on actionable factors which are known to contribute to worse cancer outcomes and to determine whether race and ethnicity-based differences exist in our community. People attending a public Covid-19 vaccination clinic at California Northstate University in Elk Grove (Sacramento County, California) were recruited to participate in a paper-based survey study which captured zip code, race/ethnicity, gender, age, income and education metrics as well as actionable factors associated with worse cancer outcomes (postponement of healthcare visits and cancer screenings, tobacco/marijuana and alcohol usage, consumption of fruits/vegetables, level of physical activity). The study was pharmacist-led. Pharmacy students as well as students from other healthcare profession programs were engaged in the distribution and collection of surveys under faculty member supervision. Our long-term goal is for our pharmacy faculty and students, and others, to use this data to provide pharmacist-led targeted outreach within our community and beyond and to thereby help improve cancer outcomes. To our knowledge, this is the first cancer outcomes-related survey study to be conducted at a Covid-19 vaccination site and is the first reported pharmacist-led study relating to this subject area.

2. Methods

This is a cross-sectional research survey study. Data for this research survey study was obtained from people attending a public Covid-19 vaccination clinic at California Northstate University in Elk Grove (Sacramento County, California) over a period of 10 days during March 2021. Anyone eligible to receive the Covid-19 vaccine per CDC guidelines during this timeframe was able to register for the clinic, there were no restrictions based on healthcare membership or coverage. Clinic registration was made available through the CalVax system. Based on registration numbers for the clinic and an anticipated 70% participation rate, we estimated that we would be able to collect 1000 completed surveys during the given timeframe. Convenience sampling was employed for this study: all Covid-19 clinic attendees were provided with a survey and invited to participate in the survey study after they had registered at the clinic. An oral overview of the research study was provided to all attendees following clinic registration and it was made clear that participation in the study was voluntary: attendees were given the option to leave their blank survey at their table if they did not want to participate in the study. If they did want to participate, they were asked to provide written consent and leave their completed survey at their table. The following inclusion criterion was applied: age 18 or older. Participants who completed the survey did not receive any compensation. This study was approved by the CNU IRB committee (protocol #2103-01-20).

The survey used in this study is a modified version of the survey developed by Scarinici et al.[41] (Appendix 1). The original survey

was developed as part of a collaboration between 17 National Institutes of Health National Cancer Institute-funded Comprehensive Cancer Centers. Unlike Scarinici et al., we did not capture perceived susceptibility to Covid-19 infection or perceptions of prevention measures. Areas that were assessed in this study included impact of the Covid-19 pandemic on cancer prevention behaviors (tobacco and/or marijuana usage, alcohol consumption, fruit and vegetable consumption, postponement of cancer screenings, access to healthcare, physical activity, access to cancer-specific healthcare, access to medications) and cancer survivor behaviors (access and adherence to treatment, including medications). Demographic data (age, race, ethnicity, income bracket, education level) were also captured.

Table 1
Participant characteristics, by race.

	Participants, No. (%)						
Characteristic	Total (N = 856 [100%])	White (n = 411 [48.0%])	Black or African American (n = 43 [5.0%])	American Indian or Alaskan Native (n = 7 [0.7%])	Asian or Asian American (n = 254 [29.7%])	Native Hawaiian, other Pacific Islander (n = 16 [1.9%])	P-value (ANOVA or Chi Squared)
Gender							0.667
Male	334 (39.0)	156 (38.0)	18 (41.9)	3 (42.9)	106 (41.7)	4 (25.0)	
Female	515 (60.2)	256 (61.6)	24 (55.8)	4 (57.1)	165 (57.1)	11 (68.8)	
Prefer not to answer	6 (0.7)	2 (0.5)	1 (2.3)	0 (0)	2 (0.8)	1 (6.3)	
Age, median (range)	46.8 (18.1, 95.5)	49.5 (18.1, 95.5)	51.3 (23.9, 83.9)	45.9 (29.0, 76.3)	45.2 (19.7, 90.3)	44.3 (20.6, 58.8)	
Diagnosed with cancer during their lifetime	55 (6.4)	35 (8.4)	3 (7.0)	0 (0)	12 (4.7)	0 (0)	0.327
General health							0.835
Excellent	208 (24.3)	100 (24.3)	7 (16.3)	2 (28.6)	66 (26.0)	4 (25.0)	
Very good	358 (41.8)	179 (43.6)	15 (34.9)	4 (57.1)	100 (39.4)	7 (43.8)	
Good	241 (28.2)	108 (26.3%)	18 (41.9)	1 (14.3)	73 (28.7)	5 (31.3)	
Fair	41 (4.8)	19 (4.6)	3 (7.0)	0 (0)	15 (5.9)	0 (0)	
Poor	3 (0.4)	1 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)	
Annual income							<0.001
$0 to $9999	25 (2.9)	5 (1.2%)	1 (2.3%)	0 (0%)	16 (6.3%)	1 (6.3%)	
$10,000 to $14,999	15 (1.8)	4 (1.0%)	0 (0%)	0 (0%)	10 (3.9%)	0 (0%)	
$15,000 to $19,999	12 (1.4)	2 (0.5%)	1 (2.3%)	0 (0%)	8 (3.1%)	0 (0%)	
$20,000 to $34,999	66 (7.7)	23 (5.6%)	3 (7.0%)	0 (0%)	27 (10.6%)	3 (18.8%)	
$35,000 to $49,999	65 (7.6)	25 (6.1%)	3 (7.0%)	0 (0%)	26 (10.2%)	2 (12.5%)	
$50,000 to $74,999	117 (13.7)	51 (12.4%)	9 (20.9%)	3 (42.9%)	35 (13.8%)	0 (0%)	
$75,000 to $99,999	119 (13.9)	59 (14.4%)	8 (18.6%)	1 (14.3%)	29 (11.4%)	3 (18.8%)	
$100,000 to $199,999	235 (27.5)	138 (33.6%)	13 (30.2%)	2 (28.6%)	50 (19.7%)	3 (18.8%)	
$200,000 or more	82 (9.6)	56 (13.6%)	5 (11.6%)	0 (0%)	11 (4.3%)	1 (6.3%)	
Education							<0.001
Less than high school	15 (1.8)	5 (1.2%)	0 (0%)	0 (0%)	8 (3.1%)	0 (0%)	
Some high school, no diploma	10 (1.2)	1 (0.2%)	0 (0%)	0 (0%)	8 (3.1%)	0 (0%)	
GED	2 (0.2)	0 (0%)	0 (0%)	2 (28.6%)	0 (0%)	0 (0%)	
High school graduate	56 (6.5)	17 (4.1%)	2 (4.7%)	0 (0%)	28 (11.0%)	1 (6.3%)	
Some college but no degree	126 (14.7)	56 (13.6%)	10 (23.3%)	1 (14.3%)	38 (15.0%)	3 (18.8%)	
Associate degree-occupational/ vocational	35 (4.1)	17 (4.1%)	1 (2.3%)	0 (0%)	11 (4.3%)	1 (6.3%)	
Associate degree-academic program	41 (4.8)	17 (4.1%)	2 (4.7%)	0 (0%)	12 (4.7%)	2 (12.5%)	
Bachelor's degree (e.g., BA, AB, BS)	319 (37.3)	159 (38.7%)	13 (30.2%)	2 (28.6%)	98 (38.6%)	5 (31.3%)	
Master's degree (e.g., MA, MS, Meng, Med, MSW)	175 (20.4)	108 (26.3%)	12 (27.9%)	1 (14.3%)	23 (9.1%)	3 (18.8%)	
Professional school degree (e.g., MD, DDS, DVM, JD)	22 (2.6)	10 (2.4%)	1 (2.3%)	0 (0%)	8 (3.1%)	0 (0%)	
Doctorate degree (e.g., PhD, EdD)	23 (2.7)	13 (3.2%)	1 (2.3%)	0 (0%)	6 (2.4%)	0 (0%)	

For our study, the survey was administered in paper format. Participants were offered paper questionnaires in the following languages: English, Chinese, Hmong, Vietnamese. Faculty members and pharmacy students who are native speakers for each language translated the surveys; each translated survey was cross-checked by at least one other native speaker. Data from paper surveys was manually entered into SurveyMonkey software. The data were extracted and then R software was used for all subsequent data analyses. Analyses were conducted using R version 4.2.1.[42] Participant responses were compared between races or ethnicities using chi-square tests. Table cells (race/response combinations) with results differing from what would be expected under independence were identified using adjusted standardized residuals.[43] Age was compared between groups using ANOVA, followed by post-hoc Dunnett testing comparing White to other races. Other and unknown races/ethnicities were not included in statistical testing, nor were responses of "Other", "Prefer not to answer", "Don't know/not sure", or not applicable responses.

3. Results

3.1. Participant demographics

A total of 949 people out of an estimated 1540 people attending a public Covid-19 vaccination clinic at California Northstate University in Elk Grove (Sacramento County, California) participated in this survey study over a period of 10 days during March 2021 (61.6% participation rate). Ninety-three completed surveys were removed based on our inclusion criteria (age = 18 or older) giving a final participant number of 856. Median age was 47.1 [18.1–95.5] years; 411 White participants (48.0%), 43 Black/African American participants (5.0%), 254 Asian/Asian American participants (29.7%), 16 Native Hawaiian/other Pacific Islander participants (1.9%), 7

Table 2
Participant characteristics, by ethnicity.

	Participants, No. (%)			
Characteristic	Total (N = 856)	Hispanic (n = 129 [15.1%])	Non-Hispanic (n = 720 [84.4%])	P value (ANOVA or Chi Squared
Gender				0.0118
Male	334 (39.0)	37 (28.7)	294 (40.8)	
Female	515 (60.2)	91 (70.5)	420 (58.3)	
Prefer not to answer	6 (0.7)	1 (0.8)	5 (0.7)	
Age, median (range)	47.1 (18.1, 95.5)	42.6 (18.6, 95.5)	47.7 (18.1, 90.3)	0.0196
Diagnosed with cancer during their lifetime	55 (6.4)	3 (2.3)	52 (7.2)	0.0607
General health				0.899
Excellent	208 (24.3)	30 (23.3%)	177 (24.6%)	
Very good	358 (41.8)	53 (41.1%)	303 (42.1%)	
Good	241 (28.2)	35 (27.1%)	203 (28.2%)	
Fair	41 (4.8)	8 (6.2%)	33 (4.6%)	
Poor	3 (0.4)	0 (0%)	2 (0.3%)	
Annual income				0.563
$0 to $9999	25 (2.9)	2 (1.6%)	23 (3.2%)	
$10,000 to $14,999	15 (1.8)	1 (0.8%)	14 (1.9%)	
$15,000 to $19,999	12 (1.4)	1 (0.8%)	11 (1.5%)	
$20,000 to $34,999	66 (7.7)	10 (7.8%)	56 (7.8%)	
$35,000 to $49,999	65 (7.6)	13 (10.1%)	52 (7.2%)	
$50,000 to $74,999	117 (13.7)	21 (16.3%)	95 (13.2%)	
$75,000 to $99,999	119 (13.9)	14 (10.9%)	103 (14.3%)	
$100,000 to $199,999	235 (27.5)	35 (27.1%)	200 (27.8%)	
$200,000 or more	82 (9.6)	11 (8.5%)	70 (9.7%)	
Education				0.625
Less than high school	15 (1.8)	4 (3.1%)	11 (1.5%)	
Some high school, no diploma	10 (1.2)	1 (0.8%)	9 (1.3%)	
GED	2 (0.2)	0 (0%)	2 (0.3%)	
High school graduate	56 (6.5)	9 (7.0%)	47 (6.5%)	
Some college but no degree	126 (14.7)	22 (17.1%)	103 (14.3%)	
Associate degree-occupational/vocational	35 (4.1)	4 (3.1%)	31 (4.3%)	
Associate degree-academic program	41 (4.8)	6 (4.7%)	34 (4.7%)	
Bachelor's degree (e.g., BA, AB, BS)	319 (37.3)	41 (31.8%)	276 (38.3%)	
Master's degree (e.g., MA, MS, Meng, Med, MSW)	175 (20.4)	33 (25.6%)	142 (19.7%)	
Professional school degree (e.g., MD, DDS, DVM, JD)	22 (2.6)	1 (0.8%)	20 (2.8%)	
Doctorate degree (e.g., PhD, EdD)	23 (2.7)	3 (2.3%)	20 (2.8%)	

American Indian/Alaskan native participants (0.7%), 129 Hispanic participants (15.1), and 720 non-Hispanic participants (84.1%) (Tables 1 and 2). There were 334 male and 515 female participants (39.0% and 60.2%, respectively). Only 3 participants requested a translated survey (Chinese). Our data indicate that significantly fewer male Hispanics participated compared to non-Hispanics (28.7% versus 40.8%, respectively, $p = 0.0118$) and Hispanic participants were significantly younger (median age of 42.6 compared to 47.7 for non-Hispanics, $p = 0.0196$). Race-related gender differences were not observed. Most of the percentages for race, ethnicity, and gender are similar to the reported demographics for Sacramento county (61.4% White, 10.9% Black/African American, Asian (17.8%), Native Hawaiian/other Pacific Islander participants (1.3%), American Indian/Alaskan native (1.6%), Hispanic (24.4%), 50.8% female)[40]. There were more Asian participants than may have been expected based on the demographic data from Sacramento county, and this may be in part due to because of the location of the clinic in Sacramento county: the city of Elk Grove has a significantly higher Asian population compared to other areas in Sacramento county [41]. There were also fewer Black participants than may have been expected based on comparison with demographic data from both Sacramento county and the city of Elk Grove.[44,45]

Statistically significant race-based differences were observed for annual income and education (Table 1, $p \leq 0.001$): fewer White participants had a combined income of $0 - $9999 and more Asian participants had incomes in this range and the $10,000 - $14,000 range than would be expected if wealth and race were independent in this cohort. Similarly, more White participants and fewer Asian participants had incomes in the $100,000 - $199,000 and $200,000 or more range than would be expected under independence. Ethnicity-based differences were not observed for income or education (Table 2). Statistically significant race-based differences were also observed for education level (Table 1, $p \leq 0.001$): more White participants had a master's degree and fewer had a high school diploma as their highest level of education compared to other races. More American Indian/Alaskan Native participants had a GED than would be expected under independence. More Asian participants had some high school/no diploma or had a high school diploma as their highest level of education and fewer had a master's degree than would be expected under independence. Ethnicity-based differences were not observed for level of education (Table 2).

Table 3
Impact of Covid-19 on cancer screening and lifestyle factors relating to cancer risk, by race.

Characteristic	Participants, No. (%)						P-value (ANOVA or Chi Squared)
	Total (N = 856 [100%])	White (n = 411 [48.0%])	Black or African American (n = 43 [5.0%])	American Indian or Alaskan Native (n = 7 [0.7%])	Asian or Asian American (n = 254 [29.7%])	Native Hawaiian, other Pacific Islander (n = 16 [1.9%])	
Postponed a scheduled cancer screening*	48 (5.6)	35 (8.5)	5 (11.6)	0 (0)	3 (1.2)	0 (0)	0.0411
Tobacco and/or marijuana usage							<0.001
Increased usage	60 (7.0)	40 (9.7)	2 (4.7)	1 (14.3)	6 (2.4)	0 (0)	
Decreased usage	30 (3.5)	8 (1.9)	6 (14.0)	0 (0)	0 (0)	11 (11.7)	
No change	503 (58.8)	278 (67.6)	19 (44.2)	3 (42.9)	123 (48.4)	8 (50)	
Consumption of fruits and vegetables							<0.001
Decreased consumption	69 (8.1)	33 (8.0)	6 (14.0)	1 (14.3)	18 (7.1)	3 (18.8)	
Increased consumption	183 (21.4)	82 (20.0)	12 (27.9)	2 (28.6)	52 (20.5)	4 (25.0)	
No change	582 (68.0)	290 (70.6)	25 (58.1)	2 (28.6)	174 (68.5)	8 (50.0)	
Alcohol consumption							<0.001
Increased consumption	69 (8.1)	77 (18.7)	5 (11.6)	1 (14.3)	16 (6.3)	2 (12.5)	
Decreased consumption	183 (21.4)	52 (12.7)	9 (20.9)	0 (0)	37 (14.6)	4 (25.0)	
No change	582 (68.0)	261 (63.5)	26 (60.5)	4 (57.1)	141 (55.5)	7 (43.8)	
Physical activity							<0.001
Decreased activity	383 (44.7)	176 (42.8)	21 (48.8)	4 (57.1)	103 (40.6)	9 (56.3)	
Increased activity	155 (18.1)	90 (21.9)	4 (9.3)	1 (14.3)	38 (15.0)	2 (12.5)	
No change	294 (34.3)	140 (34.1)	18 (41.9)	1 (14.3)	99 (39.0)	5 (31.3)	

* NOTE: A total of 152 participants (17.8%) said 'yes' to they were scheduled to have a cancer screening, this included 96 (23.4%) White, 11 (25.6%) Black or African American, 0 (0%) American Indian or Alaskan Native, 28 (11%) Asian or Asian American, and 0 (0%) Native Hawaiian and other Pacific Islander participants.

3.2. Impact of the Covid-19 pandemic on cancer screening and lifestyle factors relating to cancer risk

Our survey data indicates that the Covid-19 pandemic negatively impacted cancer screening. A total of 152 participants (17.8%) had a scheduled cancer screening appointment and of these 48 participants (5.6%) reported having postponed it for reasons relating to Covid-19 (Tables 3 and 4). Race differences were observed ($p = 0.0411$) with fewer Asian or Asian American participants reporting having postponed a screening appointment than would be expected under independence, however, fewer Asian or Asian American participants had a scheduled cancer screening appointment. White participants were more likely than other races to have a scheduled cancer screening appointment. Ethnicity-based differences were not observed for scheduling of a screening appointment or postponement of an appointment.

Out of the lifestyle factors assessed (tobacco and/or marijuana usage, consumption of fruits and vegetables, alcohol consumption, and physical activity), our survey data indicates that the Covid-19 pandemic had the largest negative impact on physical activity levels of participants (Tables 3 and 4). A total of 383 participants (44.7%) reported a decrease in physical activity while 155 (18.1%) and 294 (34.3%) of participants reported an increase in physical exercise or no change, respectively. No race or ethnicity-related differences were observed.

A negative impact on tobacco and/or marijuana usage was also observed: 60 participants (7.0%) reported increased usage during the Covid-19 pandemic compared to only 30 participants (3.5%) reporting decreased usage and 503 (58.8%) reporting no change in usage (Tables 3 and 4). More white participants reported increased usage of tobacco and/or marijuana and more Black or African American participants reported decreased usage than would be expected under independence. No ethnicity-related differences were observed.

Our survey data indicate that many participants decreased their alcohol consumption during the Covid-19 pandemic: 183 participants (21.4%) reported decreasing alcohol consumption compared to 69 participants (8.1%) who increased consumption and 585 participants (68.0%) who didn't change alcohol consumption (Tables 3 and 4). Race differences were observed: significantly more White participants reported increasing alcohol consumption and significantly fewer Asian or Asian American participants reported increasing alcohol consumption than would be expected under independence. No ethnicity-related differences were observed.

Our survey data indicate that the pandemic had a positive impact on fruit and vegetable consumption: 183 participants (21.4%) reported increased consumption of fruit and vegetables during the Covid-19 pandemic compared to 69 participants (8.1%) and 582 participants (68.0%) who reported decreased or no change in consumption of fruit and vegetables, respectively (Tables 3 and 4). No race or ethnicity-related differences were observed.

Table 4
Impact of Covid-19 on cancer screening and lifestyle factors relating to cancer risk, by ethnicity.

	Participants, No. (%)			
Characteristic	Total ($N = 856$)	Hispanic ($n = 129$ [15.1%])	Non-Hispanic ($n = 720$ [84.4%])	P value (ANOVA or Chi Squared
Postponed a scheduled cancer screening*	48 (5.6)	5 (3.9)	43 (6.0)	0.697
Tobacco and/or marijuana usage				0.520
Increased usage	60 (7.0)	9 (7.0)	43 (6.0)	
Decreased usage	30 (3.5)	8 (6.2)	22 (3.1)	
No change	503 (58.8)	71 (55.0)	428 (59.4)	
Consumption of fruits and vegetables				0.421
Decreased consumption	69 (8.1)	8 (6.2)	61 (8.5)	
Increased consumption	183 (21.4)	34 (26.4)	148 (20.6)	
No change	582 (68.0)	84 (65.1)	492 (68.3)	
Alcohol consumption				0.128
Increased consumption	120 (14%)	24 (18.6)	96 (13.3)	
Decreased consumption	127 (14.8)	24 (18.6)	102 (14.2)	
No change				
Physical activity				0.00599
Decreased activity	383 (44.7)	65 (50.4)	316 (43.9)	
Increased activity	155 (18.1)	30 (23.3)	124 (17.2)	
No change	294 (34.3)	28 (21.7)	262 (36.4)	

* NOTE: A total of 152 participants (17.8%) said 'yes' to they were scheduled to have a cancer screening, this included 21 (16.3%) Hispanics and 131 (18.2%) non-Hispanics.

3.3. Impact of the Covid-19 pandemic on access to healthcare, medications

Our survey data demonstrate that the Covid-19 pandemic negatively impacted access to healthcare, however, no race or ethnicity-based differences were observed for any of the metrics assessed (Tables 5 and 6). A large number of survey participants reported having had a medical appointment cancelled by their healthcare provider (22.8%) or having cancelled an appointment themselves (25.8%) due to concerns relating to Covid-19. A large number of survey participants also reported postponing routine vaccinations (8.8%, e.g. Shingles, flu, HPV vaccinations) for themselves or their children. The Covid-19 pandemic did not appear to have a big impact on the ability of participants to obtain prescription or over-the-counter medications (3.5% and 4.4% of participants reported being unable to obtain medications, respectively). A total of 57 participants (6%) reported having been diagnosed with cancer during their lifetime, only 2 of these participants stated that the Covid-19 pandemic had impacted their medical care (3.5%) and our survey data indicate that Covid-19 did not have a significant impact on their access to cancer-related healthcare and medications.

4. Discussion

This survey study was conducted over a 10-day period at a pharmacist-led public Covid-19 vaccination clinic held at California Northstate University (CNU) in Elk Grove (Sacramento County, California) in March 2021. To our knowledge, this is the first study to have conducted a cancer outcomes-related survey at a public Covid-19 vaccination site. It is also the first pharmacist-led study in this area. Our data indicates that the Covid-19 pandemic has had both negative and positive impacts on factors which are known to be associated with cancer outcomes. In regard to negative impacts, the data indicate that the Covid-19 pandemic resulted in postponement of cancer screenings and cancellation of medical appointments as well as decreased physical activity and increased tobacco and/or marijuana usage. Conversely, the data indicates that the Covid-19 pandemic increased consumption of fruits and vegetables and decreased consumption of alcohol. Several race-related differences but no ethnicity-related differences were observed.

Survey participation rates were high and for the most part representative of our diverse community. A slightly lower level of participation than might be expected was observed for Black and African Americans and fewer male Hispanics compared to male non-Hispanics participated. These findings align with other studies which demonstrated significantly higher levels of Covid-19 vaccine hesitancy in African American and Hispanic populations during the timeframe of our study.[46–48] Vaccination rates subsequently increased, most likely due to targeted outreach to these populations.[46,48,49] Significantly more females participated in our study compared to males. The reasons for this are unclear, however several studies have shown that women are generally more likely to participate in health research survey studies compared to men and this may at least partially help explain this observed difference.[50–52] It is likely that our engagement of pharmacy students and other healthcare professions students and our emphasis on providing culturally appropriate patient counseling, and, when possible, linguistically appropriate counseling, helped increase overall survey participation rates. At the CNU Covid-19 vaccination clinic, where this study was held, pharmacists and pharmacy students took the lead on patient counseling and vaccinations while physicians and medical students took the lead for post-vaccination surveillance thereby making the clinic an interdisciplinary effort. Students also helped with survey administration and collection under the supervision of faculty members. Other studies have demonstrated that involving medical professionals, including pharmacists, in survey administration as well as focus on cultural and linguistic competency can increase survey participation.[53,54] Pharmacy students receive extensive patient counseling and cultural competency training, and this makes pharmacists well positioned to help recruit participants

Table 5
Impact of Covid-19 on access to healthcare, access to medications.

Characteristic	Participants, No. (%)						
	Total (N = 856 [100%])	White (n = 411 [48.0%])	Black or African American (n = 43 [5.0%])	American Indian or Alaskan Native (n = 7 [0.7%])	Asian or Asian American (n = 254 [29.7%])	Native Hawaiian, other Pacific Islander (n = 16 [1.9%])	P-value (ANOVA or Chi Squared)
Participant cancelled a medical appointment	221 (25.8)	107 (26.0)	13 (30.2)	3 (42.9)	57 (22.4)	2 (12.5)	0.647
Participant's medical appointment was cancelled by facility	195 (22.8)	104 (25.3)	10 (23.3)	2 (28.6)	48 (18.9)	1 (6.3)	0.285
Participant postponed vaccinations for themselves or their children	75 (8.8)	42 (10.2)	3 (7.0)	1 (14.3)	17 (6.7)	2 (12.5)	0.673
Participant was unable to obtain one or more prescription medications	30 (3.5)	17 (4.1)	3 (7.0)	0 (0)	6 (2.4)	1 (20.0)	0.350
Participant was unable to obtain one or more over-the-counter medications	38 (4.4)	22 (5.3%)	3 (7.0%)	0 (0%)	9 (3.5%)	1 (6.3%)	0.883

Table 6
Impact of Covid-19 on access to healthcare, access to medications.

Characteristic	Participants, No. (%)			
	Total (N = 856)	Hispanic (*n* = 129 [15.1%])	Non-Hispanic (*n* = 720 [84.4%])	P value (ANOVA or Chi Squared
Participant cancelled a medical appointment	221 (25.8)	39 (30.2)	181 (25.1)	0.127
Participant's medical appointment was cancelled by facility	195 (22.8)	32 (24.8)	159 (22.1)	0.564
Participant postponed vaccinations for themselves or their children	75 (8.8)	9 (7.0)	66 (9.2)	0.643
Participant was unable to obtain one or more prescription medications	30 (3.5)	5 (3.9)	25 (3.5)	0.956
Participant was unable to obtain one or more over-the-counter medications	38 (4.4)	7 (5.4)	31 (4.3)	0.659

for research studies including cancer control-related research studies.

A key finding from our study was that the Covid-19 pandemic resulted in many people postponing cancer screenings. This aligns with what others have shown.[55,56] For example, Oakes et al. reported that breast cancer and cervical cancer screening rates dropped by as much as 40% at the start of the pandemic and have remained lower then pre-pandemic levels.[18] While significantly fewer Asians or Asian Americans reported postponing scheduled cancer screening appointments, significantly fewer Asians or Asian Americans had cancer screening appointments scheduled compared to other races. White participants reported the highest levels of scheduled cancer screenings. The combined data supports the urgent need to put mechanisms in place to actively encourage cancer screening with an emphasis placed on increasing scheduling of screening appointments for minority populations: reduced screening rates in minority population are well known to contribute to cancer health disparities.[57] Pharmacists often serve as the initial health care educator within underserved communities and they are one of the most trusted healthcare professions.[58] They are provided with training not only on cancer treatments but also on cancer risks and screenings. These attributes, and their ability to hear and observe signs of early cancer or cancer risk, allow them to advise individuals visiting their pharmacies to seek immediate medical attention and/or to educate patients on how to reduce their cancer risk. Several opinion pieces have noted that the potential exists for pharmacists to play a bigger role in cancer control efforts, and this could include placing more focus on encouraging cancer screenings.[37–39]

Our finding that a high number of participants reported decreased levels of physical activity as a result of the Covid-19 pandemic also aligns with what others have reported. For example, a recent systematic review by Mehraeen et al. demonstrated the Covid-19 pandemic reduced physical activity in all age groups regardless of race and gender.[19] Our data indicates that tobacco and marijuana usage also increased. Our survey captured tobacco and marijuana usage as a combined metric making it difficult to directly compare our data with other studies which typically assessed these separately, however, it is well known that a strong association between tobacco and marijuana usage exists[59] and therefore we believe an comparison with tobacco-specific studies is still meaningful. A report from the Federal Trade Commission, cigarette sales increased 0.4% in 2020 compared to 2019[20] and this aligns with our finding, however, a meta-analysis by Sarich et al. revealed mixed results with some studies reporting increased tobacco usage and others reporting decreased usage.[60] Results from studies which assessed marijuana usage during the pandemic are also mixed. Salles et al. reported an overall decrease in marijuana usage[61] while Black et al. reported increased usage.[62] These divergent findings indicate that community-specific assessment of tobacco and marijuana usage may be needed to help determine the urgency with which this factor needs to be addressed in individual communities. In our study, race-related differences in tobacco and marijuana usage were observed indicating that assessment by race may also be important: White participants reported increased usage of tobacco and marijuana products, while Black and African American participants decreased their usage. The latter aligns with data reported by Fucito et al. and Kowitt et al. which found that Black participants reported tobacco use reductions and intention to quit during the pandemic compared to White participants.[63,64] For the other two lifestyle factor assessed, we observed positive trends: overall, more participants reported increasing fruit and vegetable consumption and decreasing alcohol consumption as compared to the number of participants reporting decreasing consumption of fruit and vegetables and increasing consumption of alcohol. No race or ethnicity differences were observed. Our finding that fruit and vegetable consumption increased aligns with a literature review by Johnson et al.[65] as well as studies conducted in Spain, Italy, and Poland which showed healthy eating improved during Covid-19 pandemic.[66–68] It is noteworthy that Sharma et al. reported that fruit and vegetable intake decreased significantly in low-income families in the US[69] and it has been reported that food insecurity increased by approximately 10% in US households during the pandemic.[70] Based on this, it is possible that our observed increase in fruit and vegetable consumption may at least in part be due to the majority of our study participants being in higher income brackets – the most frequently reported annual income brackets were $50,000 - $74,999, $75,000 - $99,999, and $100,000 - $199,999. Further assessment of this metric in the lower income population in our community is needed. In contrast to our study, other survey studies have reported an overall increase in alcohol consumption during the pandemic.[71–74] While we observed an overall decrease, significantly more White participants reported increasing alcohol consumption compared to other races and this does align with race data reported by these other studies. The combined data indicates that targeted outreach to help reduce alcohol consumption in White adults in our community and beyond is warranted. As already noted, pharmacists receive extensive patient counseling training including smoking cessation counseling and healthy lifestyle choice counseling training and studies have demonstrated success in these areas.[27,29–35] The motivational interviewing training which pharmacists receive provides

them with another tool to help encourage heathier habits through behavior changes and further reduce cancer risk and risk of progression and/or recurrence.

The Covid-19 pandemic also had a major impact on access to healthcare. Our survey data shows that a significant number of participants either cancelled healthcare-related appointments (22.8%) or had the appointments cancelled by their providers (25.8%). This aligns with what other studies have reported: a national survey conducted by Anderson et al. found that 41% of participants reported forgoing medical care from March to July in 2020,[75] while a national survey by Wenger et al. found that 37% of participants had cancelled or postponed appointments.[21] No race or ethnicity-related differences were observed for these metrics in our study or the studies by Anderson et al. and only weak associations were observed by Wenger et al. Missing or postponing healthcare visits is well known to contribute to worse outcomes for all disease states including cancer and as such there is clearly an urgent need to follow up with patients who missed healthcare visits to help mitigate these likely worse health outcomes.[76] Very few of our study participants reported not being able to obtain prescription or over-the-counter medications, including cancer medications, and no race or ethnicity-related differences were observed. The number of participants who reported having ever been diagnosed with cancer was 6.4%, which is similar to the national average in the US of 5.5%.[77] Very few of our study participants (2 out of 35 participants, 5.7%) reported having delayed cancer-related healthcare visits and none reported changing oral cancer medication use. Ensuring timely cancer treatment is known to be extremely important in regards to improving patient survival rate.[78]

The combined data indicates that there is an urgent need to help support increased cancer screenings, especially in minority populations, and a need to help ensure that missed medical appointments have been rescheduled and any healthcare issues addressed. In addition, our data support the need for outreach efforts in our community to help promote increased physical exercise and to reduce tobacco and marijuana consumption. Our data indicate that providing targeted outreach to help reduce alcohol consumption by White adults in our community is also warranted. The related literature which we have cited strongly supports an enhanced role for pharmacists in cancer control efforts such as these. Addressing these factors is likely to help mitigate potential worse cancer outcomes in both the near and distant future. Our next step will be to use the data to help guide targeted outreach efforts within our local community. As with this survey study, these outreach efforts will be pharmacist-led and engage pharmacy students and other students with a healthcare interest. Other studies have demonstrated pharmacists can play an important role in community outreach efforts based on their training, experience, and penetrance and accessibility in all communities[27,29,30,37–39] and should continue to do so and further expand these efforts.

4.1. Study limitations

This is a single center study and as such the data presented may not be generalizable beyond our community. The data obtained are based on self-report from a convenience sample of the population and as such sampling bias exists; the data may not provide a true representation of our community. Participants' responses for the lifestyle questions could have been confounded by recall bias: the Covid-19 pandemic started in early 2019 and this survey study was conducted in March 2021. This factor has been highlighted by Cross et al. in response to similar survey studies.[6] Lastly, the study was not specifically powered to detect differences between races or ethnicities and as such the subgroup analyses by race should be interpreted with caution.

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Study approval

This study was approved by the CNU IRB committee (protocol #2103-01-80).

Footnotes

None.

CRediT authorship contribution statement

Erika Titus-Lay: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Funding acquisition, Resources, Supervision. **Jeffrey Nehira:** Methodology, Formal analysis, Investigation, Writing – review & editing. **Jennifer Courtney:** Methodology, Formal analysis, Investigation, Writing – review & editing. **Jacquelyn Jee:** Methodology, Formal analysis, Investigation, Writing – review & editing. **Marissa Kumar:** Methodology, Formal analysis, Investigation, Writing – review & editing. **Jenny Tiet:** Methodology, Formal analysis, Investigation, Writing – review & editing. **Vivi Le:** Methodology, Formal analysis, Investigation, Writing – review & editing. **Blythe Durbin-Johnson:** Methodology, Formal analysis, Investigation, Writing – review & editing. **Moon S. Chen:** Methodology, Formal analysis, Investigation, Writing – review & editing. **Ruth Vinall:** Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Funding acquisition, Resources, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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The data underlying this article will be shared on reasonable request to the corresponding author.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.rcsop.2023.100311.

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