THE IMPACT OF COVID-19 ON HEALTH, DAY-TO-DAY LIFE, AND HEALTH-RELATED BEHAVIORS: THE MULTIETHNIC COHORT STUDY

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In dedication to:

My family, for your love and support,

without hesitating at any moment of seeing my dreams come true.

My supportive mentors and friends, for your enlightenment and valuable advice.

Thank you.

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ABSTRACT

The highly contagious SARS-CoV-2 virus and the disease that it causes - Coronavirus Disease 2019 (COVID-19) - has impacted the health and day-to-day life of individuals, especially the elderly and people with certain preexisting medical conditions, including cancer. The purpose of this cross-sectional study was to better understand how COVID-19 impacted health, day-to-day life, access to care, and health-related behaviors, including breast and colorectal cancer screening, by studying the participants in the University of Hawaii Cancer Center Multiethnic Cohort (MEC) study.

The MEC was established in 1993 – 1996 and has been following over 215,000 residents of Hawai'i and Los Angeles for the development of cancer and other chronic diseases. It includes men and women of five ethnic groups: Japanese Americans, Native Hawaiians, African Americans, Latinos, and Whites. MEC participants were sent an invitation to participate in an online survey on the impact of COVID-19 on their daily life activities, including adherence to cancer screening. Approximately 7,000 MEC members responded. Responses were compared between males and females and by race/ethnicity to describe the differences between the groups.

African American men (compared to White men), women (compared to men), and men and women with more education, were more likely to make changes to their lifestyle or daily activities during the COVID-19 pandemic. So were men with heart disease, hypertension, or lung disease, COPD, or asthma, and women with hypertension or lung disease, COPD, or asthma, compared to their healthy counterparts. Native Hawaiian men and women, and men and women of Other

race/ethnicity, compared to Whites, and older men and women were less likely to make changes to their lifestyle or daily activities.

Men with more education, women compared to men, men with heart disease, and women with hypertension, kidney disease, and diagnosed with cancer in the past 5 years, compared to their healthy counterparts, were more likely to postpone regular health care visits during the COVID-19 pandemic. Latino and Native Hawaiian men, Native Hawaiian women, and older women were less likely to postpone regular health care visits.

Men with more education, men with heart disease and those diagnosed with cancer in the past 5 years, and women with hypertension, lung disease, COPD, or asthma, kidney disease, and those diagnosed with cancer in the past 5 years were more likely to postpone surgical procedures during the COVID-19 pandemic. Japanese American men and women and Native Hawaiian women were less likely to postpone any surgical procedure(s).

Lastly, women with more education, women compared to men, men diagnosed with cancer in the past 5 years, and women with lung disease, COPD, or asthma, and those diagnosed with cancer in the past 5 years were more likely to postpone any cancer screening test/procedure due to the COVID-19 pandemic. Japanese American men and women and older women were less likely to postpone any cancer screening test/procedure.

This study revealed specific associations of factors like race/ethnicity, age, education level, and comorbidities with the healthcare decisions of MEC participants during the COVID-19 pandemic in Hawai‘i and Los Angeles. Increased monitoring of patients in high-risk groups for cancer and other diseases is of the utmost importance as the chance of undiagnosed cases or poor prognosis due to delayed screening and treatment increases.

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LIST OF ABBREVIATIONS

ACE2	Angiotensin-Converting Enzyme 2
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Center for Disease Control
COPD	Chronic Obstructive Pulmonary Disease
COVID-19	Coronavirus Disease 2019
CRC	Colorectal Cancer
CT	Computed Tomography
FIT	Fecal Immunochemical test
FOBT	Fecal Occult Blood Stool Test
HDI	Human Development Index
HI	Hawai‘i
HR	Hormone Receptor
HS	High School
MEC	Multiethnic Cohort
MERS	Middle East Respiratory Syndrome
NCCN	National Comprehensive Cancer Network
NCI	National Cancer Institute
PCP	Primary Care Physician
RNA	Ribonucleic Acid
SARS	Severe Acute Respiratory Syndrome
SARS-CoV2	Severe Acute Respiratory Syndrome Coronavirus 2
SAS	Statistical Analysis System
SD	Standard Deviation
SEER	Surveillance Epidemiology and End Results
SES	Socioeconomic Status
TKN	Token
UHCC	University of Hawai‘i Cancer Center
USC	University of Southern California
U.S.	United States
WHO	World Health Organization

CHAPTER 1 – INTRODUCTION

The highly contagious Coronavirus Disease 2019 (COVID-19) has impacted the health and day-to-day life of individuals, especially the elderly and people with certain preexisting medical conditions, such as cancer. COVID-19 became a worldwide pandemic three months after its discovery in late December 2019. Prior to this outbreak, different types of Coronaviruses had led to two outbreaks, including the severe acute respiratory syndrome (SARS) in 2002–2003 and the Middle East respiratory syndrome (MERS) in 2012.[1] The severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) is the RNA virus causing COVID-19. On March 11, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic due to a 13-fold increase in the number of cases outside of China.[2] By May 1, 2020, 233,560 deaths were reported among 3,269,667 cases worldwide.[3] As of April 1, 2022, 6,143,842 deaths have been reported among 488,524,257 cases worldwide.[4] Populations at high risk of contracting COVID-19 and developing severe illness are the elderly and people of all ages with pre-existing medical conditions (such as diabetes, high blood pressure, heart disease, lung disease, AIDS, or cancer).[5] For this thesis, I will focus on the impact of COVID-19 on the health and day-to-day life of elderly residents in Hawai‘i (HI) and Los Angeles, specifically focusing on the participants in the Multiethnic Cohort (MEC) Study, and the impact of COVID-19 on their healthcare visits, surgeries/procedures, and cancer screenings.

1.1 Breast and Colorectal Cancer Incidence, Mortality, and Survival

1.1.1 INTRODUCTION TO CANCER HEALTH DISPARITIES

Cancer is a disease that affects all population groups in the United States (U.S.), but certain disadvantaged groups may have higher rates of cancer cases, deaths, and related health complications compared to other groups. These cancer health disparities are differences in cancer measures, such as incidence, prevalence, mortality, survivorship, the burden of cancer or related health conditions, screening rates, and stage at diagnosis.[6] Factors associated with cancer disparities are many, including genetic and biological risk factors, health care access, socioeconomic factors, chemical and physical exposures, diet, and physical inactivity. Frequently, health disparities are seen in people with low socioeconomic status, certain racial or ethnic populations, and those living in certain geographical areas.[6]

1.1.2 BREAST CANCER INCIDENCE RATES

Incidence refers to the occurrence of new cases of disease or injury in a population over a specified period. In 2019, Loo et al.[7] examined breast cancer incidence and mortality trends from 1984 to 2013 across the five major racial or ethnic populations of Hawai‘i – Native Hawaiians, Whites, Japanese Americans, Chinese Americans, and Filipinos. These researchers studied data from Hawai‘i’s Surveillance, Epidemiology, and End Results (SEER) cancer registry on 4,430 women with breast cancer (Figure 1.1). All racial or ethnic groups experienced increasing breast cancer incidence over the thirty years, except for Chinese American women. Japanese American women experienced the most pronounced recent increase in breast cancer cases, but their mortality rates remained low. Native Hawaiians consistently had the

highest breast cancer incidence and mortality rates. Lastly, researchers found higher incidence rates of hormone receptor (HR)-positive breast cancer among Japanese American and Native Hawaiians compared to Whites.

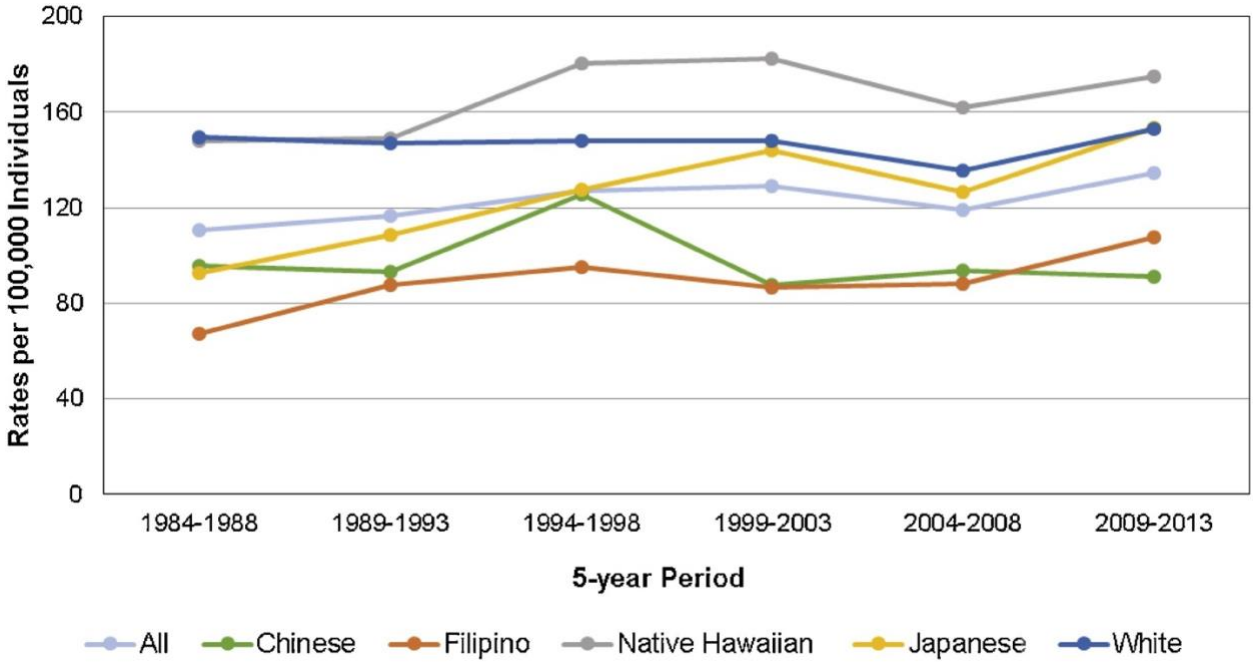
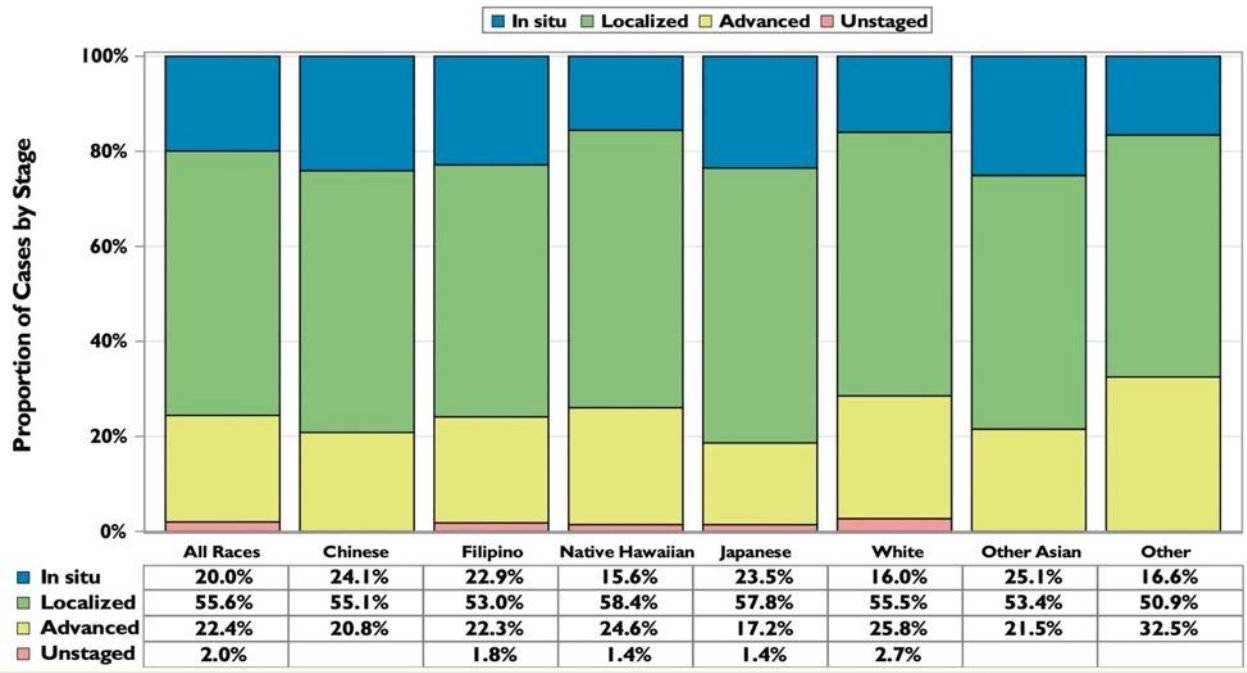


Figure 1.1 Trends in Age-adjusted Incidence Rates for Invasive Breast Cancer Among the Five Major Racial/Ethnic Populations in Hawai‘i (1984–2013)[7]

In 2007, Hausauer et al.[8] examined population-based breast cancer incidence trends separately for U.S. Asian/Pacific Islander, Hispanic, African American, and non-Hispanic White women by etiologically relevant tumor subtype characteristics. Researchers collected population-based breast cancer incidence data from 13 SEER cancer registries and abstracted demographic and tumor information for each incident case from medical records. The study examined 244,000 cases of invasive and 48,000 cases of in situ breast cancer in women over 50 years of age. Between 2001 and 2004, incidence rates of invasive breast cancer in women 50 years or older appreciably declined among Asians/Pacific Islanders and Hispanics. Incidence rates were stable in

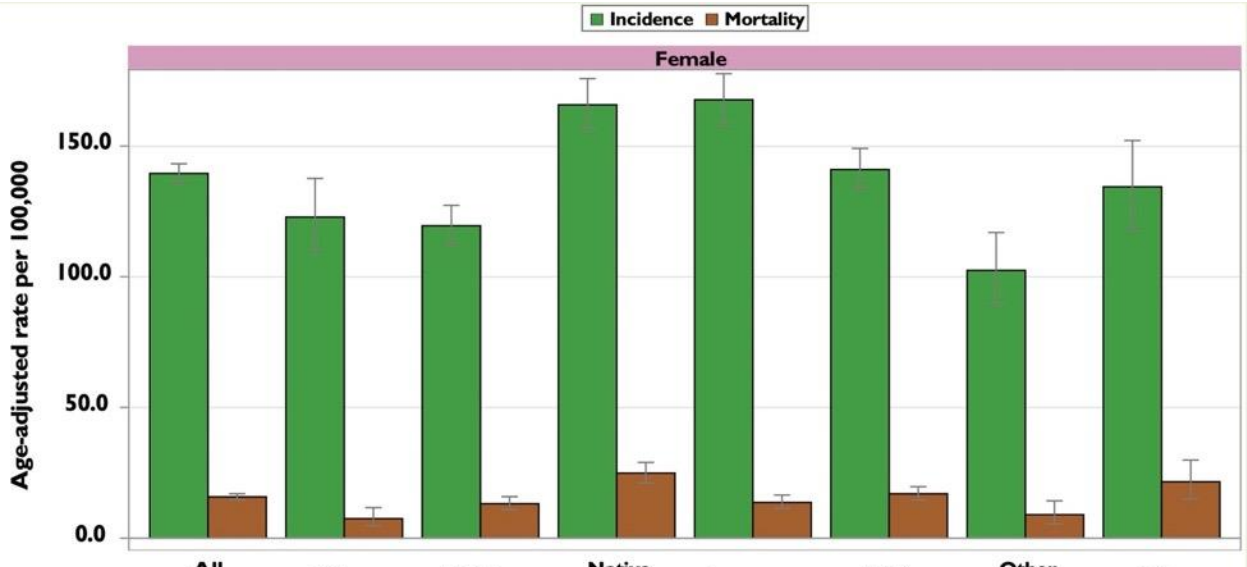
African Americans. Reductions in incidence rates in Asians/Pacific Islanders, Hispanics, and African Americans were substantially lower than those observed among non-Hispanic Whites. In Asian/Pacific Islander women, perceptible but statistically nonsignificant decreases were observed for HR-positive, lobular, and small tumors only. Rates of HR-negative tumors increased among African Americans and Hispanics from 2001 to 2004. Incidence trends in most groups, peaked between 1999 and mid-2002, except for African American women.

According to the SEER Hawai‘i Tumor Registry,[9] breast cancer is the most common cancer among women in Hawai‘i and comprises 34% of the cases. Annually, an average of 1,233 women are diagnosed with invasive breast cancer, while another 308 are diagnosed with in situ breast cancer or very early-stage tumors that have not invaded surrounding tissues (Figure 1.2). Seventy-two percent of breast cancers are diagnosed in women aged 55 and older. Breast cancer incidence was higher among Japanese American and Native Hawaiian women compared to Filipino, Chinese American, White, other Asian, and women of other race/ethnic groups (Figure 1.3). Lastly, invasive breast cancer incidence rates in Hawai‘i increased by nearly 1.7% per year over the past 10 years.



	All Races	Chinese	Filipino	Native Hawaiian	Japanese	White	Other Asian	Other
In situ	20.0%	24.1%	22.9%	15.6%	23.5%	16.0%	25.1%	16.6%
Localized	55.6%	55.1%	53.0%	58.4%	57.8%	55.5%	53.4%	50.9%
Advanced	22.4%	20.8%	22.3%	24.6%	17.2%	25.8%	21.5%	32.5%
Unstaged	2.0%		1.8%	1.4%	1.4%	2.7%		

Figure 1.2 Breast Cancer Stage Distribution, Hawai'i, 2014-2018[9]



	All Races	Chinese	Filipino	Native Hawaiian	Japanese	White	Other Asian	Other
Incidence	139.6	122.9	119.6	165.9	167.8	141.1	102.5	134.5
Mortality	15.8	7.5	13.2	24.9	13.7	17.0	9.0	21.6

Figure 1.3 Breast Cancer Incidence and Mortality, by Race/Ethnicity, Hawai'i, 2014-2018[9]

1.1.3 COLORECTAL CANCER INCIDENCE RATES

With regard to colorectal cancer (CRC), cancer of the colon is the fourth most incident cancer in the world, and cancer of the rectum is the eighth-most incident cancer. CRC comprises 11% of all cancer diagnoses with the number of diagnoses in men 3-4 times greater than in women. Developed countries have the highest risk of colon and rectal cancers. Regions of highest colon cancer incidence are Southern Europe, Australia/New Zealand, Northern Europe, and North America. Regions of highest rectal cancer incidence are Eastern Europe, Australia/New Zealand, Eastern Asia, and North America.[10]

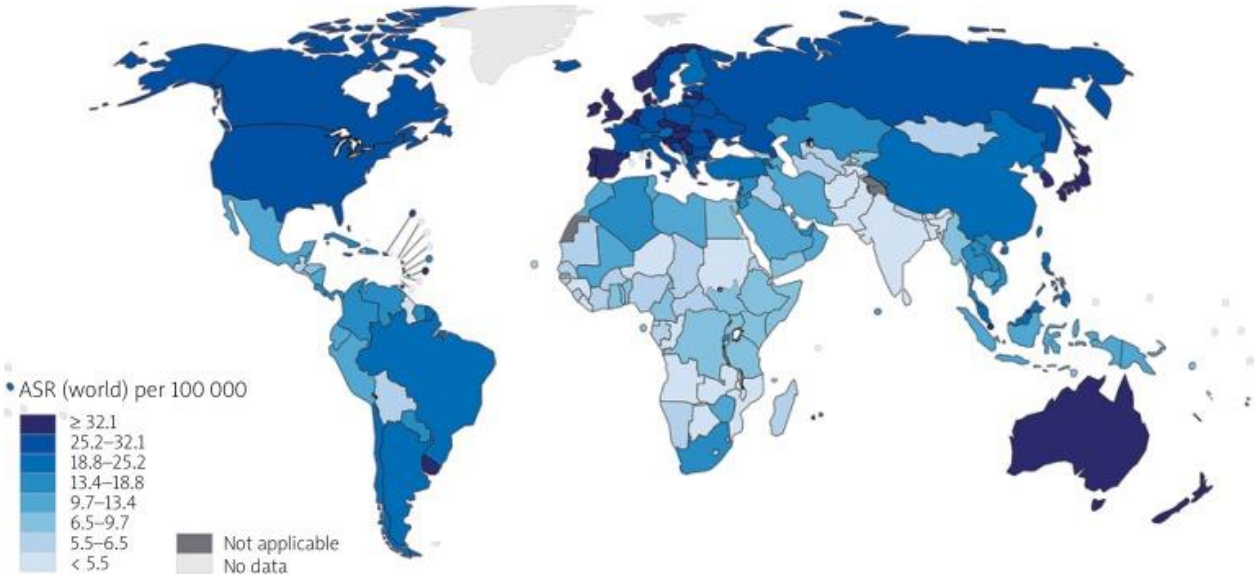


Figure 1.4 Map Showing Estimated Age-standardized Incidence Rates (World) in 2018, Colorectum Cancer, Both Sexes, All Ages (reproduced from http://globocan.iarc.fr/)[10]

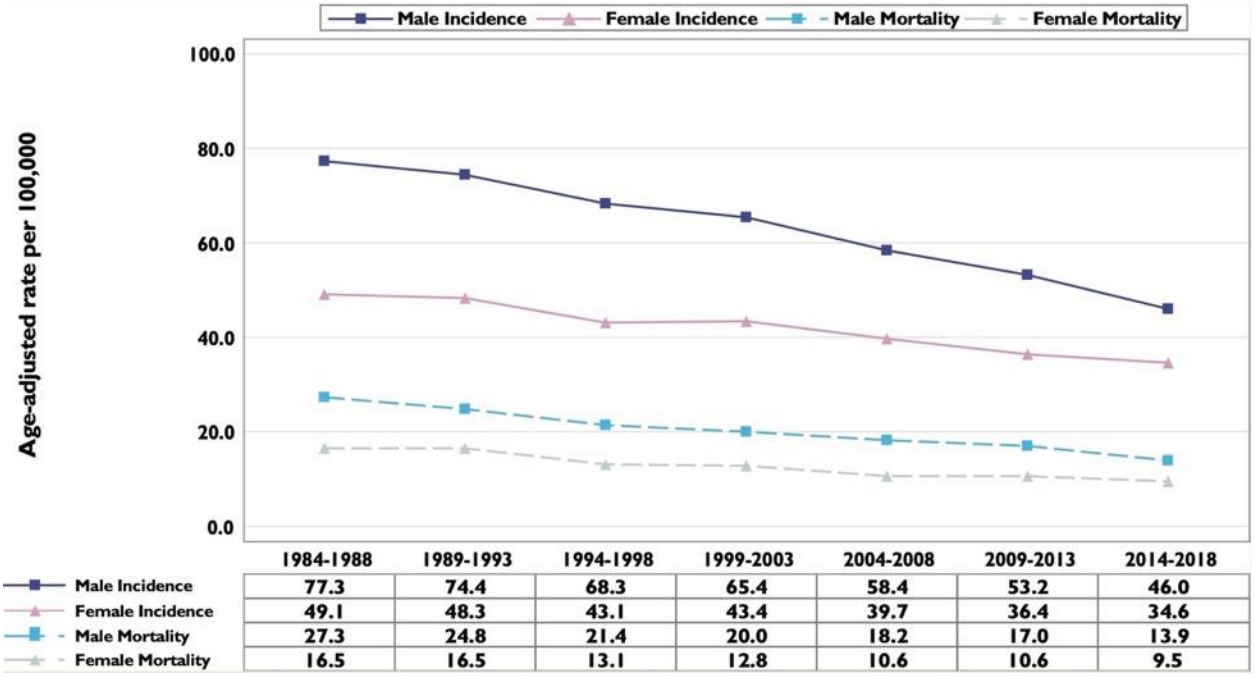
To examine the trends in CRC incidence rates by age, race/ethnicity, and indices of access to medical care from 1995 to 2004, Hao et al.[11] collected incidence data from 19 cancer registries that cover 53% of the U.S. population. The study conducted in 2009 also analyzed changes in colorectal endoscopic screening and fecal occult blood stool

test (FOBT) from 1995-1997 to 2002-2005 for the same set of county-level indicators using data from the Behavioral Risk Factor Surveillance System (BRFSS). Researchers found a significant decrease in CRC incidence rates among Whites from 1998 to 2004 in age ≥ 65, but not in age 50–64 in counties with high uninsured or poverty rates, fewer Primary Care Physicians (PCPs), or in non-metro areas. For African Americans or Hispanics, rates did not decrease in general for age 50-64 and age ≥65 in counties with high uninsured or poverty rates, fewer PCPs, or in non-metro areas. For colorectal endoscopic screening, rates increased significantly in whites in both age groups but not among Hispanics or African Americans. The rate of FOBT remained unchanged from 1995 to 2004.[11]

In addition, Ollberding et al.[12] found that Japanese Americans and African American women are at increased risk of CRC and advanced disease relative to Whites. In site-specific analyses, after multivariable adjustment, African Americans (both sexes) and Japanese American women remained at increased risk for colon cancer, and Japanese Americans (both sexes) and Native Hawaiian men for rectal cancer compared to Whites.

According to the Hawai'i Tumor Registry,[9] cancers of the colon & rectum are the 3rd most frequently diagnosed cancer in Hawai'i with an average of 710 new cases (385 men, 325 women) diagnosed each year. Eighty-three percent of colon & rectum cancers are diagnosed at age 55 years and older. Over the past decade, the rate of CRC incidence declined an average of 2.3% per year in men and 1.5% per year in women (Figure 1.5). From 2014 to 2018, the colorectal incidence was higher in Hawai'i men (46.0 per 100,000) compared to 43.5 per 100,000 in the U.S. overall. From 2014 to

2018, 38% of colorectal cancers were diagnosed at early stages, and 55% at advanced stages. Stage distribution was similar across race/ethnic groups.



	1984-1988	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018
Male Incidence	77.3	74.4	68.3	65.4	58.4	53.2	46.0
Female Incidence	49.1	48.3	43.1	43.4	39.7	36.4	34.6
Male Mortality	27.3	24.8	21.4	20.0	18.2	17.0	13.9
Female Mortality	16.5	16.5	13.1	12.8	10.6	10.6	9.5

Figure 1.5 Colon and Rectum Cancer Incidence and Mortality, 1984-2018[9]

1.1.4 BREAST CANCER MORTALITY AND SURVIVAL RATES

The mortality rate is a measure of the frequency of occurrence of death in a defined population during a specified interval. In 2007, Albano et al.[13] examined the simultaneous influence of both race and socioeconomic status on cancer incidence and mortality. They examined relationships among race, education level, and mortality from cancers of the lung, breast, prostate, colon, and rectum, and all sites combined in contemporary U.S. vital statistics. The study collected death certificate data from 2001 and examined 137,708 deaths among 119,376,196 individuals aged 25-64 years. Also, population data from the 2001 Census was collected and it contained educational level, age-standardized mortality rates for lung, breast, prostate, and colorectal cancer, sex,

and race. The study found that educational attainment was strongly and inversely associated with mortality from all cancers combined in African American and White men and White women (Figure 1.6). The death rates for all cancers combined were nearly identical for African American and White men with 0-8 years of education. African American men who completed 12 or fewer years of education had a prostate cancer death rate that was more than double that of African American men with more schooling. Breast cancer mortality rates were higher among women with less education than among women with more education.

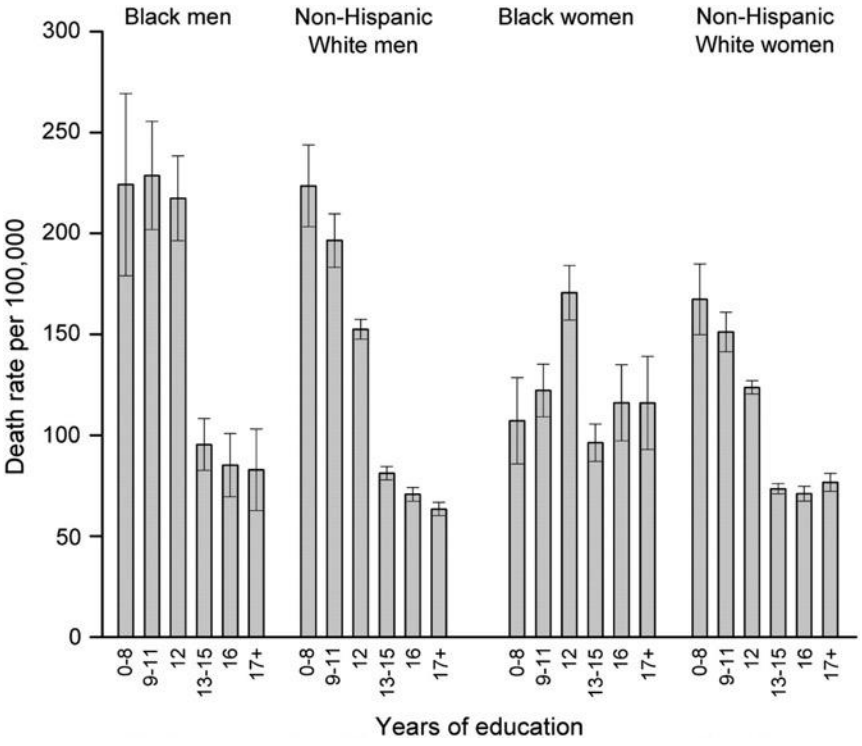


Figure 1.6 All-site Cancer Mortality Rates, by Education Level, Sex, and Race, for Persons Aged 25–64 Years in the United States, 2001 (Error bars correspond to 95% confidence intervals)[13]

The survival rate is the percentage of people that are still alive after diagnosis over a given period of time, usually five years. A study conducted in 2015 by Warner et al.[14] evaluated the relationship between race or ethnicity and breast cancer-specific

survival according to subtype and explored mediating factors. The study collected data from the National Comprehensive Cancer Network (NCCN) Breast Cancer Outcomes Database on 17,268 women with stage I to III breast cancer. The specific data collected were patient and tumor characteristics, sociodemographic information, treatment, and outcomes of women receiving care for newly diagnosed breast cancer. The study found that African Americans had a 21% higher risk of breast cancer-specific death. For estrogen receptor-positive tumors, African American and White survival differences were greatest within 2 years of diagnosis. African Americans were 76% and 56% more likely to die because of luminal A-like and luminal B-like tumors, respectively. Lastly, Asians and Hispanics were less likely to die because of breast cancer compared with Whites.

According to the Hawai‘i Tumor Registry,[9] an average of 155 women die of breast cancer each year in Hawai‘i. Invasive breast cancer mortality rates in Hawai‘i have declined approximately 1.04% per year over the past decade. Hawai‘i has among the lowest rates of breast cancer mortality in the country (15.8 per 100,000). This compares to 20.1 per 100,000 for the U.S. overall in 2014-2018. However, breast cancer mortality is high in Native Hawaiian (second only to African Americans in the US) followed by White women (Figure 1.3).

1.1.5 COLORECTAL CANCER (CRC) MORTALITY AND SURVIVAL RATES

CRC is the second most deadly cancer worldwide, with about 881,00 deaths estimated for 2018.[10] The cumulative risk, at age 0 to 74 years, of dying from colon cancer is 0.66% among men and 0.44% among women. The same risk for rectal cancer

is 0.46% among men and 0.26% among women.[15] Mortality rates of CRC worldwide in both sexes combined is 8.9 per 100,000 (Figure 1.7). The mortality from CRC varies with the developmental status of a nation, but to a lesser degree than incidence (about a 2–3-fold difference between low and high HDI (human development index). In terms of CRC survival, improvements in CRC treatment have led to decreases in CRC mortality in the second and third categories of nations, even in the face of increased incidence. The improved survival rates are in part due to the removal of polyps as the result of early detection efforts, such as colonoscopies, flexible sigmoidoscopies, computed tomography (CT) colonography, fecal immunochemistry, and fecal occult blood testing.[16] The United States (U.S.) is among the third category of highest HDI nations, which has seen a decrease in CRC incidence and mortality. However, there are variations in survival within the U.S. due to race and socioeconomic status. African Americans, Native Americans, and underprivileged minorities often with less access to quality healthcare, pre-emptive screenings, and healthy foods, suffer lower survival among all stages of CRC.[17]

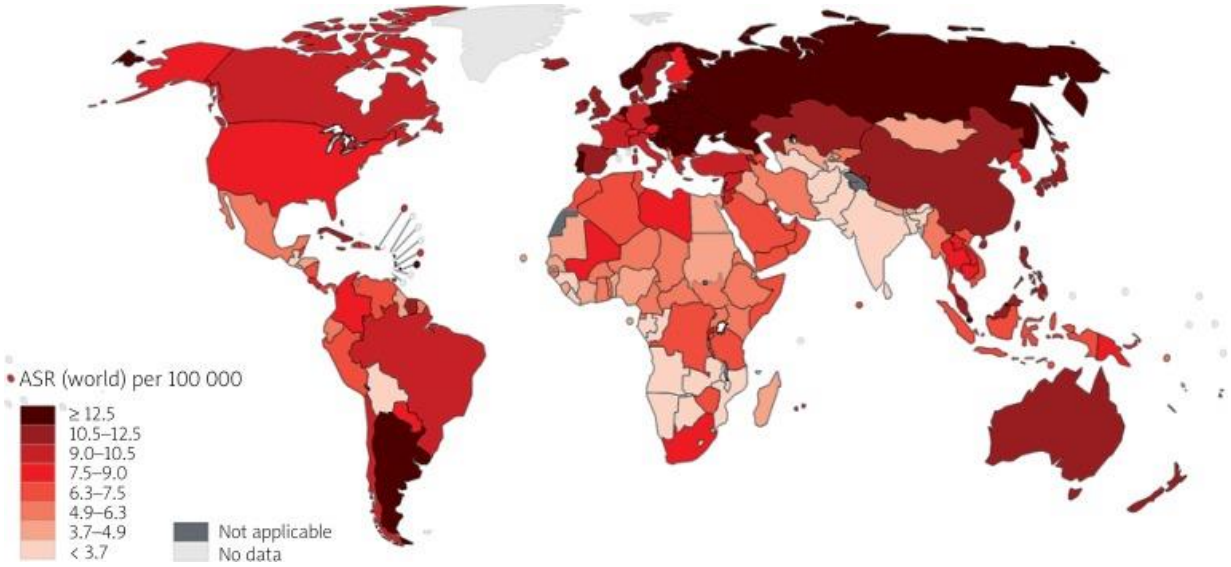


Figure 1.7 Map Showing Estimated Age-standardized Mortality Rates (World) in 2018, Colorectum Cancer, Both Sexes, All Ages (reproduced from http://globocan.iarc.fr/)[10]

A study conducted in 2020 by Clouston et al.[18] examined the association between social conditions (socioeconomic status (SES), race/ethnicity), and CRC mortality. Researchers utilized two large datasets in the U.S. that examine behavioral and medical preventive factors (from BRFSS, N = 4.63-million people) and merged with population-level mortality data (from Compressed Mortality File) observing 761,100 CRC deaths among 3.31-billion person-years of observation to examine trends in CRC mortality from 1999-2012. Examining yearly trends in the BRFSS data revealed that the use of CRC preventive behaviors improved over time with a decrease in sedentary behavior and smoking and an increase in colonoscopy use (Figure 1.8). Researchers found that a lower SES, as well as African American, Hispanic, Asian/Pacific Islander, and Native American race/ethnicity, were associated with decreased access to age-appropriate screening and/or with increased prevalence of behavioral risk factors. Further analysis revealed that these SES and racial/ethnic inequalities were partially

determined by differences in engagement in two preventive factors: use of colonoscopy and participation in physical activity.

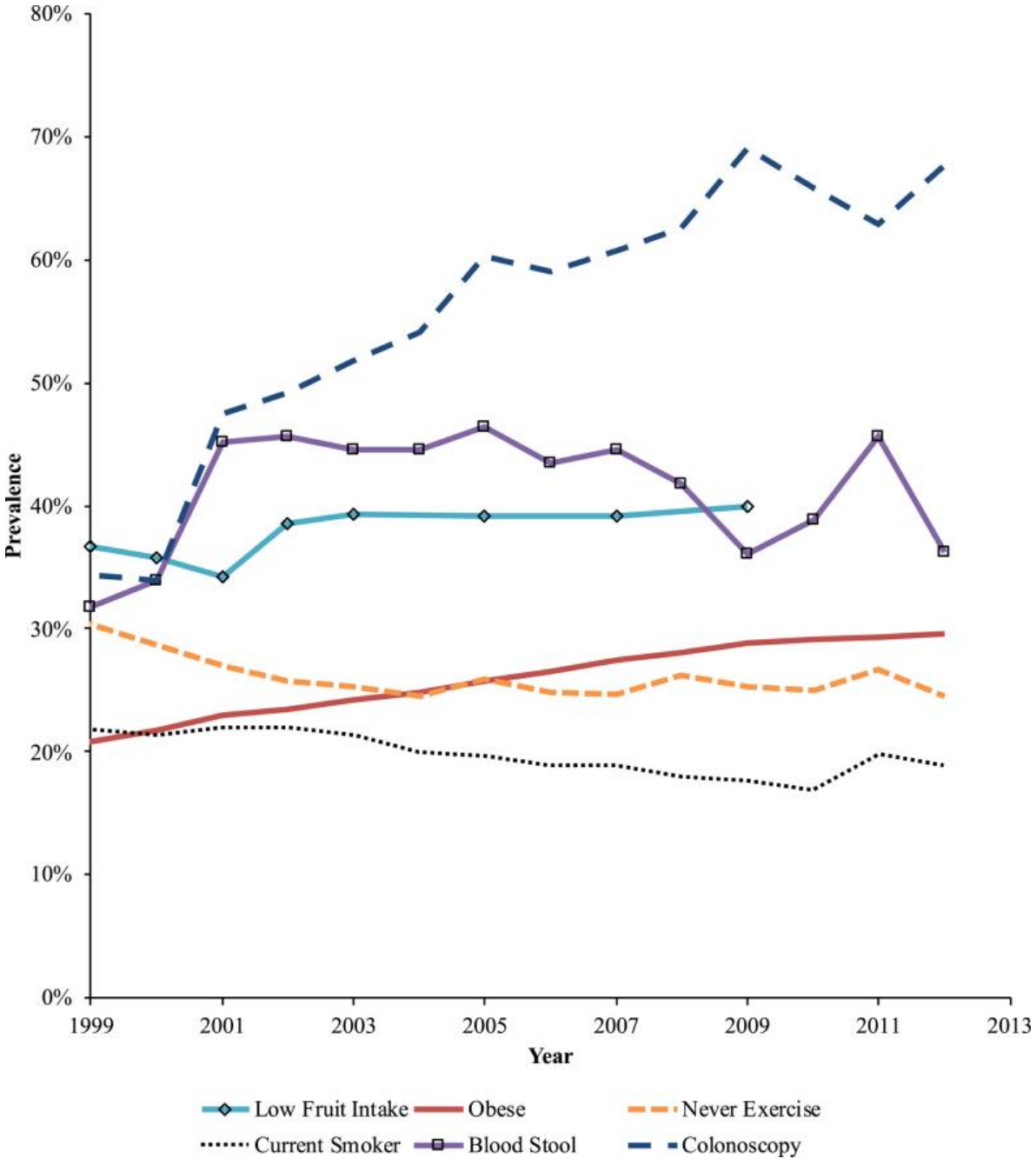


Figure 1.8 Prevalence of Behaviors Linked to Colorectal Cancer Risk and Use of Screening Techniques Weighted to the United States Resident Population Aged 25 and Older, Behavioral and Risk Factor Surveillance Study 1999–2012.[18]

According to the Hawai‘i Tumor Registry,[9] colorectal is the 2nd leading cause of cancer death in men and 3rd among women in Hawai‘i. Over the past decade, mortality rates fell 2.0% per year in men and 1.4% per year in women (Figure 1.5). From 2012 to 2016, among women, mortality was lower in Hawai‘i (10.3 per 100,000) compared to 11.9 per 100,000 in the U.S. overall.

1.1.6 CONCLUSION

In summary, after evaluating the literature on breast and colorectal cancer health disparities relating to incidence, mortality rates, and survival rates, the following conclusions are warranted:

- For Breast Cancer
    - It is important to consider the heterogeneity in breast cancer rates and tumor subtypes across the different racial/ethnic populations.[7]
    - The extent of recently reported reductions in breast cancer incidence varies considerably by race/ethnicity.[8]
    - Breast cancer incidence is higher among Japanese American and Native Hawaiian women compared to Filipino, Chinese American, White, other Asian, and women of other race/ethnic groups.[8]
    - Cancer death rates vary considerably by the level of education. Identifying groups at high risk of death from cancer by the level of education as well as by race may be useful in targeting interventions and tracking cancer disparities.[13]

    - Invasive breast cancer mortality rates in Hawai‘i have declined approximately 1.04% per year over the past decade.[9]
    - Racial disparities in breast cancer survival vary by tumor subtype.[14]
- For Colorectal Cancer
    - Individuals residing in poorer communities with lower access to medical care have not experienced the reduction in CRC incidence rates that have benefited more affluent communities. These disparities may be related to cultural influences on men and related to health care access, specifically to barriers to colorectal endoscopic screening.[11]
    - Over the past decade in Hawai‘i, the rate of colorectal cancer incidence declined an average of 2.3% per year in men and 1.5% per year in women.[9]
    - Lower SES, as well as African American, Hispanic, Asian/Pacific Islander, and Native American race/ethnicity, were associated with decreased access to age-appropriate screening and/or increased prevalence of behavioral risk factors.[18]
    - Over the past decade in Hawai‘i, mortality rates of CRC fell 2.6% per year in men and 1.7% per year in women.[9]

1.2 Impact of COVID-19 on the Elderly and Cancer Patients

Substantial information is available on the impact of COVID-19 on the elderly and cancer patients and whether the treatments received were influenced by health disparities.

The 2019 Coronavirus disease also known as COVID-19 is a severe acute respiratory syndrome caused by SARS coronavirus 2 (SARS-CoV-2). Due to the rapid spread and high infectivity rates, stay-at-home orders were decreed in many locations worldwide to allow for physical distancing and self-isolation. This led to a strong impact on people's lives, affecting their eating habits, everyday behaviors, physical activity, and often their employment.[19] In the United States, the pandemic has significantly undermined health insurance coverage due to a sudden surge in unemployment exceeding 20 million workers leading to the loss of employer-sponsored insurance for many. A Commonwealth Fund survey showed that 40% of respondents or their spouse/partner who lost a job or were furloughed had insurance through the job that was misplaced.[20]

Additionally, substantial racial and ethnic disparities have been highlighted in the healthcare system. African Americans constitute 13% of the U.S. population but account for 20% of COVID-19 cases and more than 22% of COVID-19 deaths, as of July 22, 2020. Latinos constitute 18% of the U.S. population but account for almost 33% of new cases.[21] Lastly, nearly 20% of U.S. counties are disproportionately African American and these countries have accounted for more than half of the COVID-19 cases and almost 60% of COVID-19 deaths nationally.[22]

Concerning the impact of the pandemic on the utilization of healthcare services, a systematic review of 81 studies across 20 countries was conducted by Moynihan et al.[23] The primary outcome was the change in service utilization between the pre-pandemic and pandemic periods. There were 143 estimates of changes with a median reduction of 37% in services overall, comprising of median reductions of 42% in visits, 31% in diagnostics, and 30% in therapeutics. The secondary outcome was the change in proportions of users of healthcare services with milder or more severe illnesses (e.g., triage scores). Among 35 studies reporting secondary outcomes, there were 60 estimates, with 27 studies (45%) reporting larger reductions in utilization among people with a milder spectrum of illness and 33 studies (55%) reporting no difference.

Furthermore, large disruptions to physical activity sleep, time usage, and mental health have been documented. Giuntella et al.[24] used a longitudinal dataset linking biometric and survey data from several cohorts of young adults before and during the COVID-19 pandemic. At the onset of the pandemic, average steps declined from 10,000 to 4,600 steps per day, sleep increased by 25 to 30 minutes per night, time spent socializing declined by over half to less than 30 minutes, and screen time more than doubled to 5 hours per day. From March to July 2020, the proportion of participants at risk for clinical depression ranged from 46% to 61%, up to a 90% increase in depression rates compared to the same population prior to the pandemic.

People of any age with certain underlying medical conditions are being more severely impacted as they are at an increased risk for severe illness from COVID-19. Some of those conditions include heart disease, cancer, chronic kidney disease, Chronic Obstructive Pulmonary Disease (COPD), obesity, sickle cell disease, and type

2 diabetes mellitus. Being treated for cancer increases the risk of severe illness from COVID-19, but it is not known if a history of cancer increases the risk as well. The Center for Disease Control (CDC)[25] recommends the following for patients with cancer:

- Have a conversation with your healthcare provider to discuss individual risk based on condition, treatment, and level of transmission in the community
- Continue medications or alter the treatment plan. Stock at least a 30-day supply of medications
- Do not delay life-saving treatment or emergency care

1.2.1 CHRONIC DISEASE CARE DISPARITIES DURING THE COVID-19 PANDEMIC

Chronic diseases are one of the leading causes of disability and death globally. It represents 7 out of the top 10 causes of death in the USA. Six in 10 Americans live with at least one chronic condition, such as heart disease, stroke, cancer, or diabetes. Chronic diseases are also the leading cause of disability in the USA and the leading driver of the nation's $3.8 trillion annual health care costs.[26] Since patients with chronic diseases are at an increased risk for severe illness from COVID-19, disparities in chronic disease care during the pandemic need to be highlighted. A group of researchers published a review article describing the association of comorbidities with COVID-19.[27] Figure 1.9 depicts the frequency of comorbidity and the fatality of COVID-19 infections. Of interest is that the frequency of obesity is like those of other comorbidities; however, the fatality rate is the highest. In addition, the study also summarized the mortalities, symptoms, and target sites in various morbidities in COVID-19 in Tables 1.1 and 1.2.

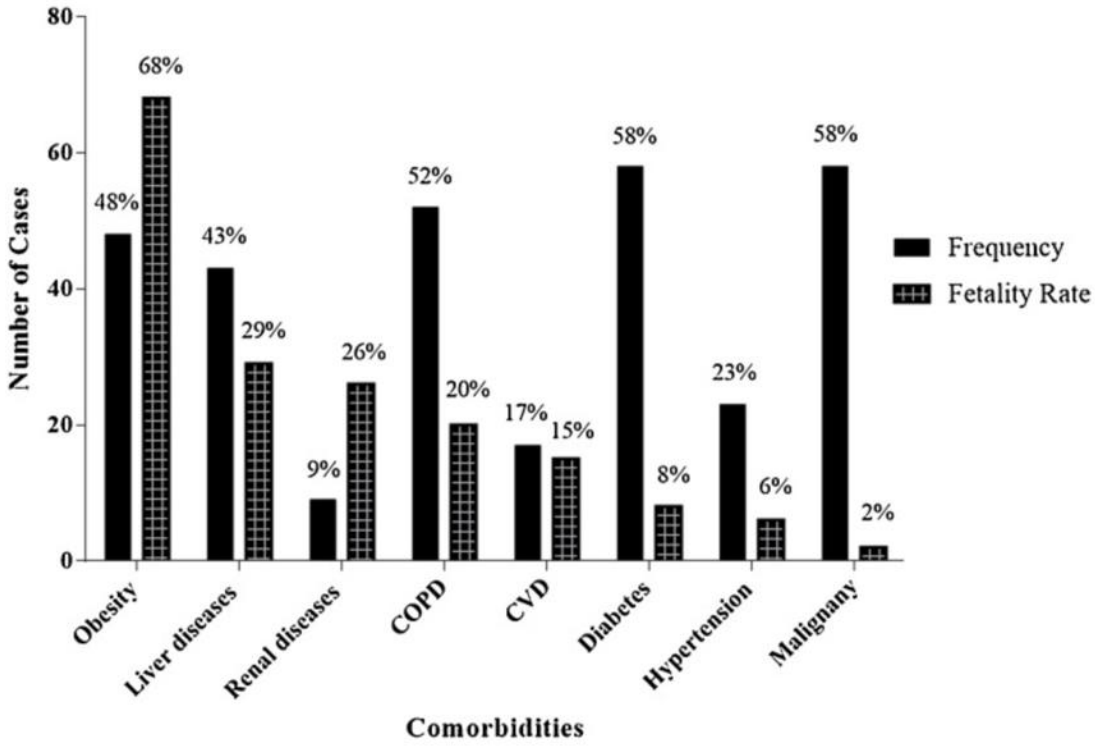


Figure 1.9 The Frequency of Comorbidity and its Fatality in COVID-19 Infections[27]

Table 1.1 Mortality Rate of COVID-19 Patients with Comorbidities.[27]

S. No.	Disease	Country with mortality %			References
		China	Italy	USA	
1	Hypertension	9.5	73.8	Not reported	[13,41,53]
2	Diabetes	7.4	35.5	58	[13,52,53]
3	COPD	7	13.7	4	[13,32,53]
4	CVD	7.3	42.5	9	[41,53,54]
5	Liver diseases	2.4	3.7	0.6	[[53], [54], [55]]
6	Obesity	13	8.5	55	[15,41,51]
7	Renal diseases	0.7	20.2	21	[13,52,53]
8	Malignancy	2	5	9.5	[15,46,49]

Table 1.2 Comorbidities, Symptoms, and Targets Concerning SARS-CoV-2[27]

S. No.	Disease	SARS-CoV-2 targets	Symptoms	References
1	Hypertension	Upregulate ACE-2 expression	Increased blood pressure with pneumonia	[20]
2	COPD	Upregulate ACE-2 expression	Severe hypoxemia	[19]
3	CVD	Impaired immune system	Myocardial injury, heart attack	[12,29]
4	Liver diseases	ACE-2 expression in liver cells, i.e., cholangiocytes, endothelial cells hepatocytes, and Kupffer cells	Elevated serum aminotransferases	[31,32]
5	Malignancy	Impaired immune system	Adult respiratory distress syndrome	[32,49]
6	Asthma	Delayed innate antiviral immune response and delayed secretion of IFN-λ	Chronic respiratory diseases along with pneumonia-like symptoms	[22,56]
7	Renal diseases	Increase secretion of enzymes, dipeptidyl peptidase-4 and angiotensin-converting enzyme (ACE-2)	Acute kidney injury (AKI)	[40,52]
8	HIV	Antiretroviral therapy (ART) with the impaired immune system and ACE-2 receptor in the lungs	Pneumonia like symptoms with jaundice	[57]
9	Obesity	The abnormal secretions of cytokines, adipokines, and interferons	Chronic low-grade inflammation of abdominal obesity with effect on bronchi and lung parenchyma	[17,51]
10	Diabetes	ACE-2 expression, impaired T-cell function and increased interleukin-6 (IL-6)	Pneumonia like symptoms	[11,58]

The relationship between COVID-19 and chronic conditions is important as chronic conditions and poor COVID-19 outcomes are tightly related. Populations most vulnerable to COVID-19 are disproportionately affected by chronic conditions. In Hawaii and the USA, these include Native Hawaiians, Other Pacific Islanders, African Americans, Hispanics, and Filipinos. In February 2021, the Journal of the American Heart Association published a paper showing that four conditions are associated with more than 60% of COVID-19 hospitalizations in the USA: diabetes, hypertension, obesity, and heart failure.[28] Additionally, the proportion of African Americans hospitalized with COVID and having 1 of these 4 conditions was higher than White, Hispanic, and Asian/other patients, of all ages, reaching up to 80% of COVID-19 hospitalizations among adults 65 years and older. A separate study examining the

Hawaii population found that Other Pacific Islanders are 14 times more likely than the general population of HI and 40 times more likely than Whites to die of COVID-19.[28]

In addition, COVID-19 and many chronic diseases are tied to the same social determinants of health. Populations with low SES and certain racial and ethnic groups (African American, Hispanic, Native American) have a disproportionate burden of chronic disease, SARS-CoV-2 infection, and COVID-19 diagnosis, hospitalization, and mortality. This is due to exposure to suboptimal social determinants of health which are factors that influence heath where people, live, work and play and create obstacles that contribute to inequities. Examples of these factors are education, type of employment, poor or no access to healthcare, lack of safe and affordable housing, lack of access to healthy food, and structural racism. The COVID-19 pandemic has exacerbated the existing health inequities.[26]

The pandemic has also affected patients psychologically. The term Coronaphobia has been termed for the fear of COVID-19.[29] A study surveyed healthcare professionals worldwide and reported that 80% of their patient's mental health worsened during the pandemic.[30] Another study found that COVID-19 caused an abnormal psychological impact in 22.8% of chronic disease patients.[29]

In addition to psychological impacts, delayed or avoided medical care might increase morbidity and mortality associated with both chronic and acute health conditions. A study found that by June 30, 2020, because of concerns from COVID-19, an estimated 41% of US adults delayed or avoided medical care including urgent or ER (12%) and routine care (32%). Avoidance of care was more prevalent among unpaid caregivers for adults, persons with underlying medical conditions, African American and

Hispanic adults, young adults, and persons with disabilities.[31] Another study by Wright et al.[32] found that in the US, comparing data from April 2020 with April 2019, colorectal cancer screenings decreased by nearly 85%, and breast cancer screenings decreased by nearly 90%.[33] A similar study examined Electronic Health Data and found preventive cancer screenings in the US abruptly dropped by 86% (colon) and 94% (breast and cervical) in May 2020. The researchers published a follow-up study in July 2020 and found that the number of cancer screenings began to rise but had not reached the previously expected levels. Looking specifically at June 16, the weekly volumes remained 29%, 36%, and 35% lower than their pre-COVID-19 levels for breast, colon, and cervical cancer screenings. This created a sizable deficit of “missed” screenings. Between March 15 and June 16, 2020, 285,000 (breast), 95,000 (colon), and 40,000 (cervical) exams were missed, which represent deficits of 63%, 64%, and 67% relative to the number of screenings that would be expected based on the historical average.[34] Lastly, a separate study examined changes in outpatient LDL cholesterol and HbA1c testing and initiation of statin and metformin therapy, as these are representative initial steps that providers might take to reduce the risk of cardiovascular events or manage diabetes. They found that from February to March 2020, the rates of testing fell by 81-90% and the rates of prescribing new medication therapy fell by 52-60% (Figure 1.10). The rates slowly started to rebound in early April 2020. This delay in care and screenings, if prolonged, will have a widespread impact on health worldwide as it can lead to later detection of diseases leading to an increased risk of severe illness.

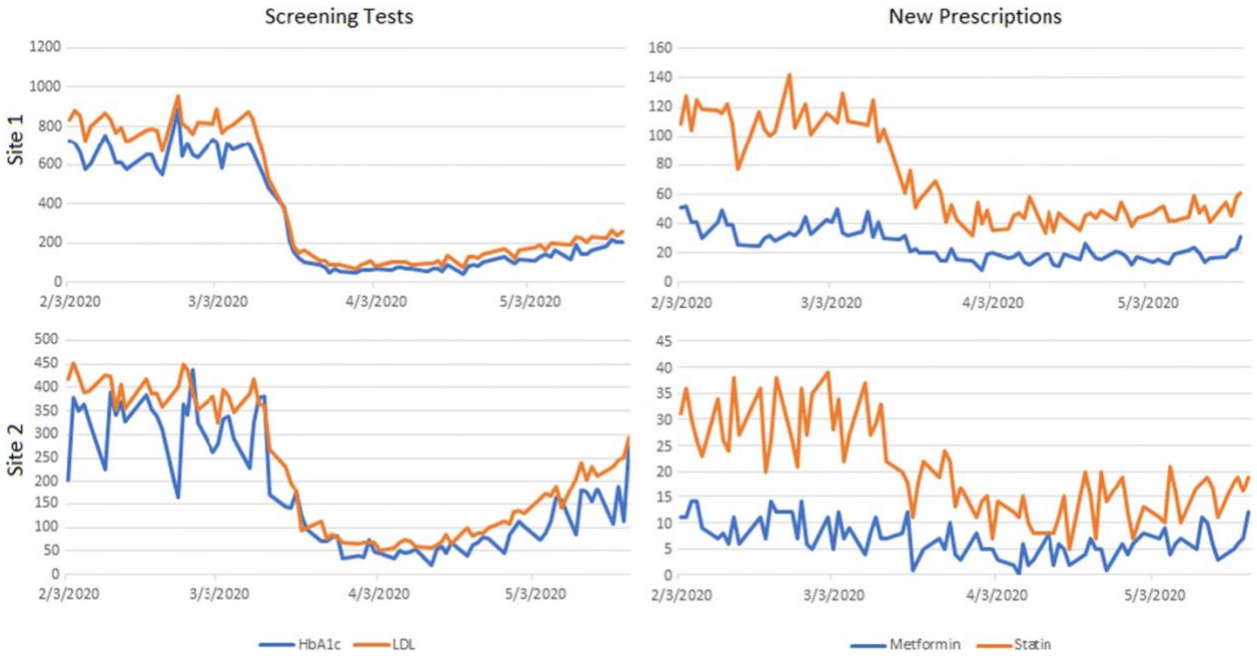


Figure 1.10 Rates of Screening Tests and New Prescriptions at Site 1 and Site 2.[32]

In summary, chronic conditions and poor COVID-19 outcomes are tightly related. Populations most vulnerable to COVID-19 are disproportionately affected by chronic conditions. Chronic diseases increase the risk for severe illness from COVID-19. COVID-19 and many chronic diseases are tied to the same determinants of health. The impact of the COVID-19 pandemic on chronic diseases includes abnormal psychological impact, delay in medical visits, screenings, and testing leading to increased risk of chronic disease development.

1.2.2 CANCER CARE DISPARITIES DURING THE COVID-19 PANDEMIC

Cancer patients are not only at a higher risk of severe illness from COVID-19 but disparities in cancer care have also been identified. One example is the finding of the COVID-19 and Cancer Outcomes Study, which is a multicenter prospective cohort study comprised of adult patients with a current or history of hematological malignancy or

invasive solid tumor who were scheduled for an outpatient medical oncology visit at the Tisch Cancer Institute, Icahn School of Medicine at Mount Sinai in New York City, and the Dana-Farber Cancer Institute, Boston. Researchers found that 10% of patients in the cohort had treatment delayed during the pandemic, and of that 10%, 48% had treatment delayed due to a COVID-19 diagnosis.[35] In the United States, COVID-19 has disproportionately affected racial and ethnic minorities, particularly African Americans, with an observed two-fold higher rate of hospitalization and a greater than two-fold higher rate of death, as compared to White Americans. The disparity seen with COVID-19 is consistent with patterns of disparities observed for cancer; it is well-documented that 5-year survival rates for multiple cancers are lower in African Americans compared to White Americans. While cancer is a multifactorial disease that is influenced by genetic and environmental factors, COVID-19 is an infectious disease that is enabled by the cellular expression of angiotensin-converting enzyme 2 (ACE2) receptors. However, preexisting comorbidities, socioeconomic disadvantages, living conditions, health literacy, and access to health care appear to fuel underlying risk for both cancer and COVID-19 disparities.[36]

1.2.3 ACCESS TO COLORECTAL CANCER SCREENING

In addition, the pandemic has affected access to cancer screenings, especially for CRC and breast cancer. The recommendation for CRC screening is to use an annual fecal immunochemical test (FIT) or colonoscopy every 10 years among average-risk adults aged 50 to 75 years.[37] Screening and appropriate follow-up can reduce incidence and mortality, which is important because CRC is the second leading cause of cancer death in the United States.[38] Another study found that CRC screening rates

are particularly low in Hispanics, Asians, recent immigrants, those with low incomes, and the uninsured.[38] Another study found that during the COVID-19 pandemic, colorectal cancer screenings dropped by 84.5%.[33]

1.2.4 ACCESS TO BREAST CANCER SCREENING

For breast cancer, the recommendation is biennial breast cancer screening with mammography in women ages 50 to 74 years.[37] Breast cancer is the most common non-cutaneous malignancy and the 2nd most lethal form of cancer among women in the United States. A study found that the incidence rate of breast cancer before age 45 is higher among African American women than White women, but for the ages of 60 to 84, breast cancer incidence rates are strikingly higher in White women than in African American women. However, African American women are more likely to die from breast cancer at every age.[39] In the MEC, Native Hawaiians have the highest risk, followed by Japanese American and Whites.[40] Nationwide, the breast cancer mortality rate is 40% higher for African American patients compared with White patients.[41] During the COVID-19 pandemic, a study found that breast cancer screenings dropped by 89.2%.[33]

1.2.5 IMPACT OF EDUCATION LEVEL ON BREAST, CERVICAL, AND COLORECTAL CANCER SCREENING

Some studies have suggested that educational attainment is associated with adherence to cancer screenings. For breast and cervical cancer screenings, a study found a positive association between the level of education and adherence to mammography screening. The researchers also found that the odds of having at least one Pap test over three years were 96% higher for women with the highest education level than the lowest.[42] For colorectal cancer, a study was conducted in 2016 utilizing

data from the 2012 Behavioral Risk Factor Surveillance System (BRFSS) within the Veteran Health Administration (VHA). The study examined the association between education and CRC screenings among U.S. veterans 50-75 years old. Researchers estimated that their population had 6.5% of participants with less than a high school (HS) education, 30.5% that are HS graduates, 37.0% with some college, and 26.1% with a college degree or more. Researchers found that 73% of individuals with less than an HS education, 77% of HS graduates, 84% of those with some college, and 87% of those with a college degree or more have obtained CRC screenings. Researchers concluded that the education level and income level show a statistically significant dose-dependent direct association with screening.[43]

1.2.6 CONCLUSION

In summary, COVID-19 has impacted medical care delivery, access to cancer screenings, health-related behaviors, and the day-to-day life of individuals worldwide. However, the full impact of the pandemic on cancer screenings and cancer care is not entirely known.

CHAPTER 2 – PURPOSE

The purpose of this thesis is to better understand how COVID-19 is impacting the health, day-to-day life, access to care, and health-related behaviors, including breast and colorectal cancer screening, by studying the participants in the Multiethnic Cohort (MEC) study. MEC participants were surveyed to understand the spread of COVID-19, to identify factors that affect the disease's course and severity, and to understand symptoms of the disease and the general impact on daily life and medical care. Since some studies have suggested that race/ethnicity and educational attainment are associated with health behaviors, we may be able to test COVID-19 affected MEC participants' life differentially by race and education level, and/or other factors associated with them.

2.1 Hypothesis

Participants with less education, more elderly, of a race/ethnicity other than White, or having one or more risk factors for serious COVID-19 illness, such as cancer, diabetes, and obesity, will be more likely to delay or skip their follow-up medical visits and cancer procedures.

2.2 Aims of the Thesis

Specific Aim 1. To evaluate the relationship between delaying or skipping follow-up care, cancer screenings, or wellness appointments, as reported in the COVID-19 baseline questionnaire, and having one or more risk factors for severe COVID-19 disease.

Specific Aim 2. To evaluate the effect of education level on cancer screening behavior during the COVID-19 pandemic.

- Educational attainment was surveyed in the MEC questionnaires and cancer screening behavior during the pandemic was surveyed in the online COVID-19 questionnaire.

Specific Aim 3. To evaluate if sex, ethnicity/race, and age play a role in behavior differences towards postponing healthcare visits, surgeries/procedures, and cancer screenings.

- Once we determine whether having risk factors for COVID-19 affects screening behavior, we can further evaluate if certain variables can explain the differences in screening behavior.

CHAPTER 3 – METHODS

3.1 Study Population

The Multiethnic Cohort (MEC) was established in 1993 – 1996 at the University of Hawai‘i Cancer Center (UHCC) and the University of Southern California (USC) with the goals of elucidating lifestyle and genetic risk factors responsible for explaining the ethnic/racial disparities that exist for cancer and other chronic diseases.[44] The cohort has followed over 215,000 residents of Hawai‘i and Los Angeles, aged 45 to 75 years old at recruitment, and includes men and women of five main ethnic groups: Japanese Americans, Native Hawaiians, African Americans, Latinos, and Whites. Approximately 100,000 MEC members (median age: 82) were still alive as of 2019. Information on preexisting and incident medical conditions or chronic diseases was collected from participants through the initial and follow-up questionnaires. MEC allows us to examine cancer-related health disparities during the COVID-19 pandemic and allows us to make comparisons among different ethnic groups and between sexes. Demographics (i.e., race/ethnicity, maximum years of education attained, birthplace) and other risk factor variables (Body Mass Index (BMI), history of diabetes, etc.) are available from the MEC baseline questionnaire and database

3.2 Study Design

In May 2020, in response to the arising COVID-19 pandemic, MEC participants were sent an invitation to participate in an online survey (implemented in Qualtrics) on the impact of COVID-19 on their everyday life and health-related behaviors. Emails were sent to over 39K and a letter to 100K MEC participants. The first and second mail

invitation was sent to all MEC participants, while the third invitation was sent to those who were 75 or younger. Paper baseline surveys were provided to participants if requested. Upon receiving the invitation, participants were asked to go to https://O-Service.cc.hawaii.edu/COVID-19 (a website located at UHCC) using their web browser and register by providing their Email address, First name, Middle name, Last name, Sex, Birth year, and Zip Code, which were required fields during registration. The entered data was used to link each participant back to the MEC database to determine which participant had registered. Two fields (MEC ID & AREA – identifies the location of the participant, Hawai'i or Los Angeles) can be used to link the COVID-19 survey registrant's record to the MEC study. Populating ID and AREA in the registration table was manual and labor-intensive as the computer program was able to match 30-40% direct exact matches. The remaining registration records were resolved manually. Two optional fields for phone and cell numbers were included for possible contact if needed. A unique token (TKN) was created once a participant registered, and their identifying information was safely stored in a live SQL server located at UHCC. Next, participants were emailed a link to the baseline survey hosted on Qualtrics. The link to the baseline survey was embedded with a TKN that linked the survey back to the registration record. The only way to match the baseline survey to an individual was via the link with the embedded TKN. A Spanish registration page was added to allow registration in Spanish and these responses were identified using the code lang='SP' when saved in the database after participants were provided a link to the Spanish baseline survey. The surveys themselves were "anonymous" as directly identifying information of participants was not collected or stored on Qualtrics. The baseline survey was followed by weekly,

then monthly, invitations to complete a shorter follow-up online survey (Figure 3.1). The surveys started in May 2020 and ended in April 2021. The last baseline survey was collected on September 25, 2020.

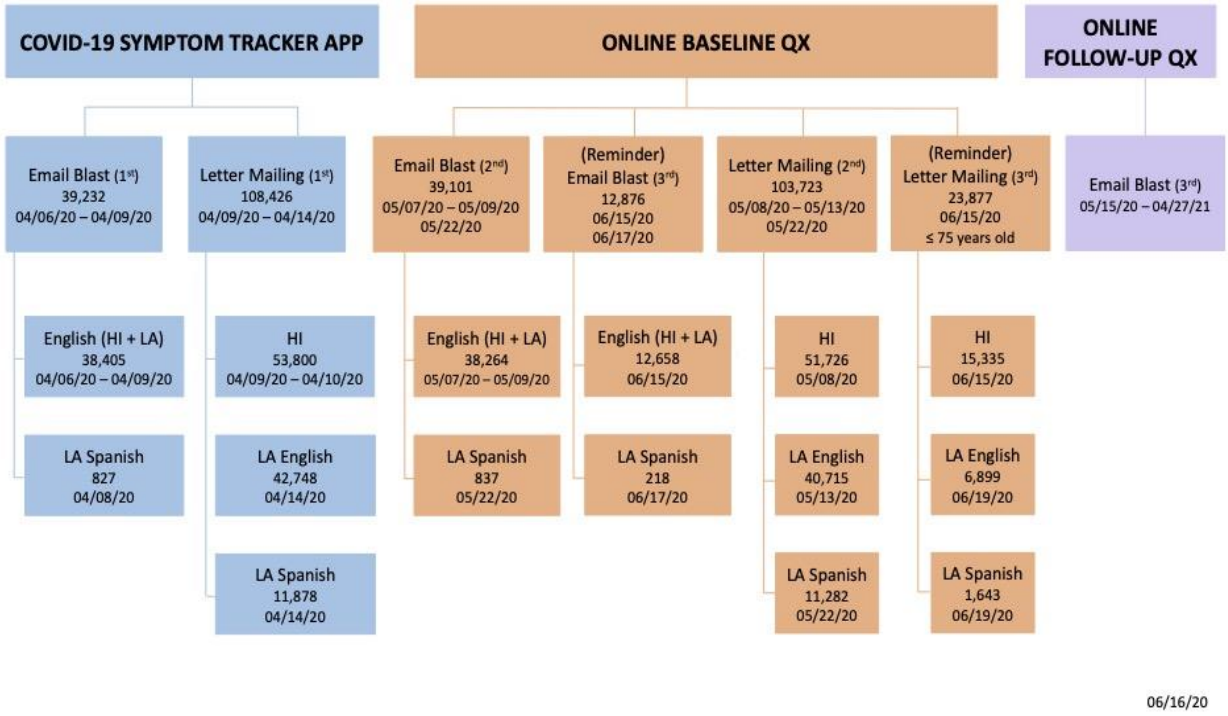


Figure 3.1 Timeline of the MEC COVID-19 Study

3.3 Survey Content and Data Editing

The baseline survey consisted of 104 questions (Appendix B). The first question asked for the participants' consent. If consent was not given, then the survey ended. Next participants were asked questions on demographics, health status, comorbidities, and medication use. Then, the questions focused on changes to lifestyle or daily activities using multi-select questions of mitigation methods or reasons for leaving their residence. This section was followed by questions about COVID-19 diagnosis and related symptoms, questions about the effect on mental health and sleep, and questions

about financial difficulties. Lastly, participants were asked if due to the COVID-19 pandemic they had to postpone any healthcare visits and specified which specialist or provider, any surgeries/procedures, and any cancer screening test/procedure and specified what type of screening. They were also asked if they avoided getting urgent care at a hospital emergency room or an emergency clinic due to COVID-19 and if they are currently on cancer treatment.

Twenty duplicated entries were found by sorting by paper first then online, keeping the first record where there was duplication of AREA ID, which identifies where the participant participates from.

For the question asking about postponing regular health care visits, “Primary care physicians, Oncologists, Cardiologists, Endocrinologists, and Dentists” were the given answer choice options. An “Other Specialists”, “Other Healthcare Provider”, and “Other Specify” option was also given for this question. The Other Specify option allowed for text responses. These responses were sorted using the Statistical Analysis System (SAS) to create the new categories found under Other and to reduce the frequency of unsorted responses. Some responses were in Spanish, so a translation tool was utilized. The original number of responses for Other Specialist was 632 for men and 1,004 for women. The original number of responses for Other Healthcare Provider was 204 for men and 453 for women. After sorting, the responses, respectively, for men were 15 and 21 and for women 23 and 47, for Other Specialist and Other Healthcare Provider, respectively.

For the question asking about postponing surgeries/procedures, answer choices for the type of surgical procedure were not provided. Participants were asked to specify

the type of surgery using a text response box; some participants answered yes to postponing a procedure but did not specify the type in the follow-up question. The text responses were sorted into the categories of dermatology, eye, dental, orthopedic, or other/unspecified.

For the question asking about postponing of cancer screenings, three additional screening categories were created by sorting text responses from the “Other, Specify” answer choice: cervical cancer screening, imaging, and other.

For the questions in Table 4.8, some of the answer choices were regrouped from five separate categories to three categories to allow for more even distribution. Also, for some questions, there was an answer choice of “S” in addition to “Y” = Yes and “N” = No. “S” is from the Spanish language participants answering 'Si' which means 'Yes' so all “S” responses were regrouped with “Y.”

The following variables from the MEC baseline questionnaire were added to the survey data before analysis: ethnicity, Dietary Quality index (Patterns Healthy Eating Index-2010 score), maximum years of education obtained, alcohol intake, height in inches, and weight in pounds to calculate BMI, pack-years, and smoking status.

3.4 Statistical Analysis

All surveys with at least 50% completion were analyzed. Descriptive statistics were used to summarize patient demographics by mean ± standard deviation (SD) for continuous variables and by frequencies and percentages for categorical variables. A cross-sectional analysis investigated the relationships between reported changes in lifestyle or daily activities since the onset of the COVID-19 pandemic or postponement of regular health care visits, surgical procedures, and cancer screening test/procedures,

overall and compared by ethnicity, age, education, and co-morbidity. Chi-square tests and binary logistic regression models were used to calculate odds ratios, 95% confidence intervals, and P-values (≤ 0.05 was taken as statistically significant) to describe these relationships using SAS, stratified by sex. For ethnicity, Whites were set as the reference group when assessing associations with race/ethnicity (Japanese American, Latino, Native Hawaiian, African American, and Other). For comorbidities, the reference was reporting no comorbidity. This was primarily a descriptive study, so no power computation was conducted.

CHAPTER 4 – RESULTS

4.1 Demographics of Survey Participants

Table 4.1 presents the number and characteristics of the COVID-19 survey participants. A total of 6,974 MEC members answered the baseline survey with 6,068 via the online survey and 906 via the paper survey. Fewer men (3,034; 43.5%) than women (3,940; 56.5%) responded. The survey response rate was 7.2% for men and 6.3% for women. The racial/ethnic group with the highest response rates was Whites (13.2% of men; 12% of women, followed by Japanese Americans (8.9; 7.4), Native Hawaiians (7.3; 7.5), Other (2.7; 4.5), African Americans (2.7; 2.8), and Latinos (2.2; 2.0) (Supplementary Table A.1). The most represented race/ethnicity was White (45.2% of men; 42.7% of women), followed by Japanese American (34.9%; 30.3%), Latino (7.9%; 7.4%), Native Hawaiian (6.4%; 8.1%), African American (3.5%; 6.5%), and Other (2.0% ; 4.9%). The ethnicity category of Other comprised a majority of Chinese Americans (38.1%) and Filipino (36.6%).

The mean ± SD for age in years was similar in men (76 ± 4.9) and women (76 ± 5.3). The mean maximum years of education attained was also similar in men (15.86 ± 2.1) and women (15.48 ± 2.2). The mean pack-years at the MEC baseline was higher in men (8.57 ± 12.4) than in women (5.16 ± 9.9). So was the mean alcohol intake (g/day) at the MEC baseline (12.65 ± 20.7 vs 5.15 ± 11.8). In the COVID data, the mean for “Number of Days an Alcoholic Beverage Consumed in the previous 2 weeks” was 4.61 ± 5.6 for men and 2.83 ± 4.7 for women. The mean Number of Days with 5 or More Drinks Consumed on the Same Occasion in the Past 2 Weeks was 0.37 ± 1.8 for men and 0.07 ± 0.8 for women. The mean for the Dietary Quality index (Patterns Healthy

Eating Index-2010 score) was 64.95 ± 10.8 for men and 68.66 ± 10.5 for women. The mean body mass index (kg/m^2) was 26.8 ± 4.6 for men and 25.9 ± 5.8 for women.

Overall, 78.8% of men and 84.4% of women reported making changes to their lifestyle or daily activities due to COVID-19 since March 2020. Among men, 4.2% and 6.3% reported drinking more and drinking less during the COVID-19 pandemic, respectively. The corresponding %'s for women were 4.3 and 5.2%. Only 3.7% of men and 2.6% of women were current smokers. Lastly, 99.2% of men and women reported having healthcare coverage, and 97.0% of men and 97.4% of women have a primary care provider/physician (Table 4.1).

Regarding the participants' health status, 3.5% and 19.7% of men had health problems that require them to stay at home and limited activities, respectively. The corresponding %'s for women were 4.9 and 19.3%. The majority of the participants lived with a spouse (77.9% of men; 50.4% of women) and resided in a detached dwelling (77.3%; 71.8) (Supplementary Table A.2). In addition, the survey respondents had a wide range of comorbidities with hypertension (48% of men; 47.1% of women) the most prevalent, followed by diabetes (18.3%; 14.4%), and heart disease (20.8%; 10.6). Lastly, the most frequently used medication was aspirin (37.9% of men; 28.1% of women), followed by Blood Pressure Medication ending in –sartan (29.3%; 26.0%), and Blood Pressure Medication ending in -pril (25.8%, 16.4%) (Supplementary Table A.3)

Table 4.1 Demographics of Survey Participants from Hawai'i and Los Angeles at Baseline (N = 6,974)

		Male	Female
		3,034 (43.5)	3,940 (56.5)
Race/Ethnicity	White	1,371 (45.2)	1,683 (42.7)
	Japanese American	1,059 (34.9)	1,195 (30.3)
	Latino	241 (7.9)	291 (7.4)
	Native Hawaiian	194 (6.4)	320 (8.1)
	African American	107 (3.5)	257 (6.5)
	Other [a]	62 (2.0)	194 (4.9)
Age Distribution	66 – 72.8	715 (23.57)	946 (24.01)
	72.8 – 74.6	787 (25.94)	1008 (25.58)
	74.6 – 77.9	796 (26.24)	979 (24.85)
	77.9 – 102	736 (24.26)	1007 (25.56)
	Age	76 ± 4.9	76 ± 5.3
	Maximum Years of Education Attained [b, c]	15.86 ± 2.1	15.48 ± 2.2
	Pack Years [b, c] (MEC baseline)	8.57 ± 12.4	5.16 ± 9.9
	Alcohol Intake [b, c] (g/day) (MEC baseline)	12.65 ± 20.7	5.15 ± 11.8
	Number of Days an Alcoholic Beverage was Consumed in the Past 2 Weeks [b, c]	4.61 ± 5.6	2.83 ± 4.7
	Number of Days with 5 or More Drinks Consumed on the Same Occasion in the Past 2 Weeks [b, c]	0.37 ± 1.8	0.07 ± 0.8
	Dietary Patterns Healthy Eating Index-2010 score [b, c] (MEC Baseline)	64.95 ± 10.8	68.66 ± 10.5
	Made Lifestyle and Healthcare Changes Due to COVID-19 Since March 2020 [c]	2,361 (78.8)	3,272 (84.4)
Drinking Behavior Change Due to COVID-19[3]	Do Not Drink	1,185 (39.6)	2,051 (53.5)
	Drink More	125 (4.2)	163 (4.3)
	Drink Less	189 (6.3)	199 (5.2)
	Same	1,492 (49.9)	1,421 (37.1)
	BMI (kg/m^2) [b, c]	26.8 ± 4.6	25.9 ± 5.8
Smoking Status[3]	Never	1,320 (44.0)	2,275 (58.7)
	Not currently, but in the past	1,568 (52.3)	1,505 (38.8)
	Yes	110 (3.7)	99 (2.6)
Have Healthcare Coverage[3]	Yes	2,972 (99.2)	3,837 (99.2)
	I don't know / not sure	3 (0.1)	2 (0.1)
	No	21 (0.7)	28 (0.7)
	Has Primary Care Provider/Physician [c]	2,908 (97.0)	3,767 (97.4)

[a] Comprised of a majority of Chinese Americans (38.1%) and Filipino (36.6%)

[b] Mean ± SD; other numbers are counts (and percentages)

[c] For education attained, there are missing responses from 16 men and 27 women. For the other questions asked in the MEC baseline and COVID survey, the missing responses range from 35-51 for men and 57-106 for women.

4.2 Confirmed or Presumed/Self-Reported COVID-19 Cases by Ethnicity and Sex

Overall, 49 men reported an episode of COVID-19 (7 confirmed and 42 presumed cases), respectively. The corresponding number of cases was 68 in women (5 confirmed, 63 presumed) (Table 4.2). The number of cases was highest in Latino men (3.8%).

Table 4.2 Positive Case of COVID-19*

Ethnicity	No.	Positive Case of COVID-19*		
		Confirmed N (%)	**Presumed N (%)**	**Total N (%)**
Male				
Latino	241	4 (1.7)	5 (2.1)	9 (3.7)
African-American	107	1 (0.9)	1 (0.9)	2 (1.9)
Japanese American	1,059	1 (0.1)	5 (0.5)	6 (0.6)
White	1,371	0 (0)	27 (2.0)	27 (2.0)
Native Hawaiian	194	1 (0.5)	4 (2.1)	5 (2.6)
Other	62	0 (0)	0 (0)	0 (0)
Total	3,034	7 (0.2)	42 (1.4)	49 (1.6)
Female				
Latino	291	0 (0)	6 (2.1)	6 (2.1)
African-American	257	0 (0)	5 (2.0)	5 (1.9)
Japanese American	1,195	3 (0.3)	11 (0.9)	14 (1.2)
White	1,683	2 (0.1)	35 (2.1)	37 (2.2)
Native Hawaiian	320	0 (0)	4 (1.3)	4 (1.3)
Other	194	0 (0)	2 (1.0)	2 (1.0)
Total	3,940	5 (0.1)	63 (1.6)	68 (1.7)

*Includes cases confirmed by testing and presumed/self-reported cases

4.3 Distribution of Ethnicity Compared With MEC Survivors

In Table 4.3, the distribution of ethnicity of the MEC cohort survivors in 2019 was compared with the distribution of the COVID survey participants in 2021. For both males and females, the COVID survey respondents included a larger representation of Whites and Japanese Americans and a smaller representation of Latinos and African Americans. Native Hawaiians were similarly represented.

Table 4.3 Comparing the Ethnicity of 2019 MEC Cohort Survivors With 2021 COVID Survey Participants

Ethnicity	Alive (%)	
	2019 MEC Cohort (N = 106,356)	**COVID Survey Cohort (N = 6,974)**
Male		
White	24.4	45.2
Japanese American	27.2	34.9
Latino	27.0	7.9
Native Hawaiian	6.2	6.4
African-American	9.4	3.5
Other	5.8	2.0
Total	N = 42,232	N = 3,034
Female		
White	22.1	42.7
Japanese American	25.7	30.3
Latino	23.4	7.4
Native Hawaiian	6.6	8.1
African-American	15.3	6.5
Other	6.8	4.9
Total	N = 64,124	N = 3,940

4.4 Educational Level of COVID-19 Survey Participants Compared With Entire MEC Cohort

Table 4.4 compares the distribution of respondents' educational level in the original MEC cohort[44] with that of the COVID-19 survey participants. A greater percentage of COVID-19 survey respondents had at least some college education compared to the original cohort. This pattern of higher education was observed for each racial/ethnic group.

Table 4.4 Distribution (%) of the 2021 COVID Survey Respondents by Educational Level and Comparison With the Entire MEC Cohort*, Hawai'i and Los Angeles, 1993–1996

Male and Female	Educational level							
	≤8 years		9–12 years		Vocational		At least some college	
	MEC	COVID	MEC	COVID	MEC	COVID	MEC	COVID
Ethnicity								
White	3.4	0	24.0	6.8	4.5	2.4	68.3	90.8
Japanese American	4.0	0.1	36.6	7.0	12.8	9.0	46.6	83.9
Latino	35.2	8.1	33.6	20.4	6.5	5.9	24.7	65.6
Native Hawaiian	3.2	0.2	49.6	21.1	8.0	8.2	37.5	70.5
African-American	7.5	0	34.9	10.0	6.1	3.3	51.5	86.7

*MEC members of other racial/ethnic backgrounds were left out of the table.

4.5 Postponing Regular Health Care Visits Due to COVID-19

54.2% of men and 61.2% of women participants reported having had to postpone their regular health care visits due to COVID-19. Primary care physician and dentist visits were the most frequently postponed with 858 and 1,188 reports for men and 954 and 1,453 reports for women, respectively (Table 4.5).

Table 4.5 Distribution for Postponing Regular Health Care Visits Due to COVID-19 Pandemic by Sex (N = 6,974)

	Male N (%)	Female N (%)
Postponed regular health care visits	1,625 (54.2)	2,369 (61.3)
Missing	38	72
Primary care physician	858	1,188
Oncologist	54	105
Cardiologist	207	147
Endocrinologist	44	74
Dentist	954	1,453
Other*:		
Dermatology	156	218
Eye	248	411
ENT	44	67
OB-GYN	0	105
Orthopedist	36	62
Podiatrist	31	39
Urologist	70	27
Neurologist	27	28
Rheumatologist	15	50
Pulmonologist	19	35
Audiologist	24	50
Allergist	2	15
Gastroenterologist	5	10
Laboratory Testing/Imaging	21	140
Physical/Massage/Chiropractic Therapy	34	89
Other specialists	15	23
Other health care provider	21	47

*Primary care physician, Oncologist, Cardiologist, Endocrinologist, and Dentist were given answer choice options. All other categories were sorted from the text responses for specifying the “Other specialist or health care provider.”

4.6 Postponing Surgical Procedures Due to COVID-19

Overall, 6.4% of men and 6.3% of women had to postpone a surgical procedure due to COVID-19. The type of surgical procedure that had the highest number of postponements was eye surgery (38 for men; 66 for women), which included procedures to treat glaucoma, cataract, and retinal damage (Table 4.6).

Table 4.6 Distribution for Postponing Surgical Procedures Due to COVID-19 Pandemic by Sex (N = 6,974)

	Male N (%)	Female N (%)
Postponed any surgical procedure(s)	192 (6.4)	244 (6.3)
Missing	40	77
Dermatology*	19	18
Eye*	38	66
Dental*	16	25
Orthopedic*	30	39
Other*	63	53

*Categories created by sorting text responses in “Other Specify” answer choice.

4.7 Avoiding Urgent Care and Postponing Cancer Screening Test/Procedure/Treatment Due to COVID-19

0.7% of men and 1.4% of women avoided getting urgent care at a hospital emergency room or an emergency clinic. 5.7% of men and 11.0% of women had to postpone any cancer screening or procedure due to COVID-19. The screening procedure the most frequently missed was mammography (n=264), followed by skin examination (n=207) and colorectal cancer screening (n=114). In the past five years, 917 survey participants had been diagnosed with cancer (Supplementary Table A.3). Importantly, 103 men (3.4%) and 135 women (3.4%) reported that they currently received cancer treatment: chemotherapy: 31 men; 30 women; immunotherapy: (22 and 19) and radiation therapy (16 and 8). Among cancer patients still receiving treatment, 11.5% of men and 6.9% of women had to cancel at least one treatment session due to COVID-19 (Table 4.7).

Table 4.7 Distribution for Avoiding Getting Urgent Care and Postponing Cancer Screening Test/Procedure/Treatment Due to COVID-19 Pandemic by Demographics and Comorbidities (N = 6,974)

	Male N (%)	Female N (%)
Avoided getting urgent care at a hospital emergency room or an emergency clinic	22 (0.7)	52 (1.4)
Missing	43	86
Postponed any cancer screening test/procedure	169 (5.7)	422 (11.0)
Missing	48	87
Breast cancer screening (e.g., mammography, breast MRI)	-	264
Colorectal cancer screening (e.g., FOBT test, FIT test, colonoscopy, sigmoidoscopy)	42	72
Skin cancer screening (e.g., skin exam)	83	124
Prostate cancer screening (digital rectal examination, PSA)	25	-
Cervical cancer screening (e.g., PAP smear, pelvic exam)*	-	18
Imaging (e.g., CAT scan, DEXA, MRI) *	12	24
Other[1]	24	29
Currently on chemotherapy, immunotherapy, or radiation therapy for cancer	103 (3.4)	135 (3.4)
Chemotherapy	31	30
Immunotherapy	22	19
Radiation Therapy	16	8
Postponed any cancer therapy session(s)	7 (11.5)	4 (6.9)
Missing	2973	3882

*Categories created by sorting text responses in “Other Specify” answer choice.

4.8 Effect of COVID-19 on Mental Health and Sleep

Among men, 25.9% and 35.4%, reported to be moderately, and very/extremely concerned about themselves or someone in their family contracting COVID-19, respectively. The corresponding %'s for women were 26.0 and 36.3%. Furthermore, 13.1% and 11.6% of men reported to be moderately, and very/extremely concerned about not being able to get medical care, respectively. The corresponding %'s for women were 13.7 and 14.3. Similarly, 16.8% and 18.8% of men reported to be a little/not at all, moderately, and very/extremely concerned about not being able to take care of family members if they get sick, respectively. The corresponding %'s for women were 14.9 and 20.6. Moreover, 12.8% and 10.5% of men reported being moderately and very/extremely concerned about not being able to obtain food, supplies, or medicine, respectively. The corresponding %'s for women were 11.9 and 12.4%. Finally, 17.4% and 12.0% of men reported being moderately and very/extremely concerned about their investment or retirement savings going down, respectively. The corresponding %'s for women were 17.8 and 16.0%.

On average, 6.9% and 21.7% of men and 8.8% and 20.6% of women, respectively, reported sleeping (including naps) 5 and 6 hours a day during the past two weeks. Among men, 16.9% and 17.5% reported having trouble getting to sleep or staying asleep 1 or 2 times a week and 3 or more times a week during the past two weeks, respectively. The corresponding %'s for women were 23.8 and 18.5%. Similarly, 9.8% and 1.4% of men, respectively, rated their overall sleep quality as fairly bad and very bad during the past two weeks. The corresponding %'s for women were 10.0 and 1.0%. Compared to before COVID-19, 7.7% and 0.6% of men, respectively, reported

that their sleep quality has been somewhat worse and much worse during the past two weeks. The corresponding %'s for women were 11.6 and 0.7%.

More women (34.1%) than men (19.8%) reported that they felt nervous, anxious, or on edge during the past two weeks. Similarly, 24.7% of women and 14.5% of men reported not being able to stop or control worrying during the past two weeks and 23.8% of women and 17.4% of men reported having little interest or pleasure in doing things during the past two weeks. Finally, 24.8% of women, compared to 16.3% of men, reported that they felt down, depressed, or hopeless during the past two weeks (Table 4.8).

Table 4.8 Effect of COVID-19 on Survey Participants' Mental Health and Sleep from Hawai'i and Los Angeles at Baseline (N = 6,974) (Continued on next page)

	Answer Choices:	Male N (%)	Female N (%)
How concerned are you about the following?*			
Me or someone in my family getting sick from coronavirus?	Little or Not at all	1,158 (38.7)	1,460 (37.7)
	Moderately	777 (25.9)	1,008 (26.0)
	Very, Extremely	1,061 (35.4)	1,406 (36.3)
Not being able to get medical care?	Little or Not at all	2,254 (75.3)	2,781 (72.0)
	Moderately	392 (13.1)	528 (13.7)
	Very, Extremely	348 (11.6)	552 (14.3)
Not being able to take care of family members if I get sick?	Little or Not at all	1,928 (64.4)	2,483 (64.5)
	Moderately	502 (16.8)	574(14.9)
	Very, Extremely	562 (18.8)	794 (20.6)
Not being able to obtain food, supplies, or medicine?	Little or Not at all	2,299 (76.7)	2,924 (75.7)
	Moderately	384 (12.8)	461 (11.9)
	Very, Extremely	313 (10.5)	480 (12.4)
Investment or retirement savings going down?	Little or Not at all	2,116 (70.6)	2,557 (66.3)
	Moderately	522 (17.4)	685 (17.8)
	Very, Extremely	358 (12.0)	617 (16.0)
On average, over the past two weeks, how many hours <u>in a day</u> did you sleep (including naps)? *	5 or less	207 (6.9)	341 (8.8)
	6	651 (21.7)	795 (20.6)
	7	907 (30.3)	1,295 (33.5)
	8	789 (26.3)	960 (24.8)
	9	327 (10.9)	349 (9.0)
	10 or more	115 (3.8)	128 (3.3)
Over the past two weeks, how often did you have trouble getting to sleep or staying asleep? *	None	1,454 (48.5)	1,451 (37.5)
	Less than once a week	513 (17.1)	781 (20.2)
	1 or 2 times a week	505 (16.9)	918 (23.8)
	3 or more times a week	524 (17.5)	715 (18.5)
Over the past two weeks, how would you rate your sleep quality overall? *	Very good	914 (30.5)	1,272 (32.8)
	Fairly good	1,748 (58.3)	2,174 (56.1)
	Fairly bad	295 (9.8)	389 (10.0)
	Very bad	42 (1.4)	39 (1.0)

Table 4.8 Continued

Compared to before COVID-19, would you say the quality of your sleep during the past two weeks has been: *	Better	99 (3.3)	151 (3.9)
	As good	2,650 (88.5)	3,238 (83.8)
	Somewhat worse	229 (7.7)	447 (11.6)
	Much worse	17 (0.6)	26 (0.7)
Over the last 2 weeks, how often have you been bothered by the following problems? *			
Feeling nervous, anxious, or on edge	Not at all	2,341 (78.1)	2,546 (65.9)
	Several	558 (18.6)	1,059 (27.4)
	More than half, or Nearly every day(s)	97 (3.2)	258 (6.7)
Not being able to stop or control worrying	Not at all	2,561 (85.5)	2,909 (75.3)
	Several	367 (12.3)	765 (19.8)
	More than half, or Nearly every day(s)	66 (2.2)	190 (4.9)
Little interest or pleasure in doing things	Not at all	2,474 (82.6)	2,943 (76.2)
	Several	414 (13.8)	740 (19.2)
	More than half, or Nearly every day(s)	108 (3.6)	179 (4.6)
Feeling down, depressed, or hopeless	Not at all	2,506 (83.6)	2,907 (75.2)
	Several	429 (14.3)	815 (21.1)
	More than half, or Nearly every day(s)	61 (2.0)	142 (3.7)

*The missing responses ranged from 35-42 for men and 66-89 for women.

4.9 Risk of Changes to Lifestyle or Daily Activities Due to the COVID-19 Pandemic by Sex, Race/Ethnicity, Age, Education, and Co-morbidity

Compared to White men, Native Hawaiian men were 41% (95% CI: 0.42, 0.84; p=0.0033) and Other men were 56% (95% CI: 0.25, 0.78, p=0.0045) less likely, and African American men were 154% (95% CI: 1.30, 4.99; p=0.0067) more likely to make any changes to their lifestyle or daily activities since the COVID-19 pandemic. Compared to White women, Native Hawaiian women were 56% (95% CI: 0.33, 0.60; p<.0001) and Other women were 38% (95% CI: 0.41, 0.92; p=0.02) less likely to make any changes to their lifestyle or daily activities since the COVID-19 pandemic.

Older men were 2% per year of age (95% CI: 0.96, 1.00; p=0.02) and older women were 3% per year of age (95% CI: 0.96, 0.99; p=0.0005) less likely to make any changes to their lifestyle or daily activities. Compared to men, women were 62% (95% CI: 1.42, 1.84; p<.0001) more likely to make any changes to their lifestyle or daily activities. Men with more education were 12% per year of education (95% CI: 1.07, 1.17; p<.0001) and women with more education 10% per year of education (95% CI: 1.06, 1.15; p<.0001) more likely to make changes to their lifestyle or daily activities.

Compared to men with no comorbidity, men with heart disease were 41% (95% CI: 1.11, 1.80; p=0.0056), those with hypertension 34% (95% CI: 1.11, 1.62; p=0.0024), and those with lung disease, COPD, or asthma 41% (95% CI: 1.01, 1.96; p=0.04), more likely to make changes to their lifestyle or daily activities. Compared to women with no comorbidity, women with hypertension were 21% (95% CI: 1.00, 1.47; p=0.05), and those with lung disease, COPD, or asthma 65% (95% CI: 0.70, 1.76; p=0.0011), more likely to make changes to their lifestyle or daily activities.

Table 4.9 Odds Ratio* for Change in Lifestyle or Daily Activities Since Onset of COVID-19 Pandemic by Demographics and Comorbidities

	Male (N = 3,000)			Female (N = 3,890)		
	Yes (n)	Odds Ratio (95% CI)	P-Value	Yes (n)	Odds Ratio (95% CI)	P-Value
Ethnicity**						
White (N = 3,031)	1,083	1.00		1,448	1.00	
Japanese American (N = 2,228)	833	1.02 (0.83,1.26)	0.83	994	0.86 (0.69,1.07)	0.17
Latino (N = 520)	177	0.99 (0.70,1.40)	0.96	233	0.94 (0.65,1.35)	0.73
Native Hawaiian (N = 509)	135	0.59 (0.42,0.84)	0.003	235	0.44 (0.33,0.60)	<.0001
African American (N = 354)	96	2.54 (1.30,4.99)	0.01	211	0.96 (0.64,1.43)	0.82
Other (N = 248)	37	0.44 (0.25,0.78)	0.01	151	0.62 (0.41,0.92)	0.02
Age (Years) (N = 6,890)	2,361	0.98 (0.96,1.00)	0.02	3,272	0.97 (0.96,0.99)	0.001
Maximum Education Obtained (Years) (N = 6,847)	2,347	1.12 (1.07,1.17)	<.0001	3,248	1.10 (1.06,1.15)	<.0001
Comorbidities***						
Heart Disease (N = 1,035)	519	1.41 (1.11,1.80)	0.01	356	1.19 (0.86,1.63)	0.29
Hypertension (N = 3,271)	1,169	1.34 (1.11,1.62)	0.002	1,545	1.21 (1.00,1.47)	0.05
Diabetes (N = 1,106)	424	0.87 (0.68,1.10)	0.25	462	0.90 (0.69,1.16)	0.40
Lung Disease, COPD, or Asthma (N = 819)	249	1.41 (1.01,1.96)	0.04	466	1.65 (1.22,2.23)	0.001
Kidney Disease (N = 340)	138	1.37 (0.87,2.13)	0.17	150	1.11 (0.70,1.76)	0.65
Diagnosed w/ Cancer in past 5 yrs. (N = 921)	383	1.09 (0.84,1.40)	0.51	383	1.21 (0.89,1.64)	0.22

*Adjusted for the other variables in the table.
*Male (Reference) vs. Female: OR = 1.62 (95% CI: 1.42,1.84; p<.0001)
**Reference is White
***Reference is “no comorbidity”

4.10 Risk of Postponing Regular Health Care Visits Due to the COVID-19 Pandemic by Sex, Race/Ethnicity, Age, Education, and Co-morbidity

Compared to White men, Latino men were 26% (95% CI: 0.55, 0.99; p=0.04) and Native Hawaiian men 36% (95% CI: 0.47, 0.88; p=0.0051) less likely to postpone regular health care visits due to the COVID-19 pandemic. Compared to White women, Native Hawaiian women were 40% (95% CI: 0.47, 0.78; p=0.0001) less likely to postpone regular health care visits due to the COVID-19 pandemic.

Older women were 2% less likely per year of age (95% CI: 0.97, 0.99; p=0.0006) to postpone regular health care visits. Men with more education were 4% more likely per year of age (95% CI: 1.00, 1.08; p=0.04) to postpone regular health care visits. Compared to men, women were 43% (95% CI: 1.29, 1.58; p<.0001) more likely to postpone regular health care visits.

Compared to men with no comorbidity, men with heart disease were 37% (95% CI: 1.13, 1.65; p=0.0011) more likely to postpone regular health care visits. Compared to women with no comorbidity, women with hypertension were 16% (95% CI: 1.00, 1.33; p=0.04), those with kidney disease 49% (95% CI: 1.05, 2.11; p=0.03), and those diagnosed with cancer in the past 5 years 51% (95% CI: 1.21, 1.88; p=0.0003), more likely to postpone regular health care visits.

Table 4.10 Odds Ratio* for Postponing Regular Health Care Visits Due to COVID-19 Pandemic by Demographics and Comorbidities

	Male (N = 2,998)			Female (N = 3,881)		
	Yes (n)	Odds Ratio (95% CI)	P-Value	Yes (n)	Odds Ratio (95% CI)	P-Value
Ethnicity**						
White (N = 3,026)	770	1.00		1,042	1.00	
Japanese American (N = 2,224)	560	0.88 (0.74,1.04)	0.13	715	0.93 (0.80,1.09)	0.38
Latino (N = 519)	114	0.74 (0.55,0.99)	0.04	187	1.32 (0.99,1.76)	0.06
Native Hawaiian (N = 508)	88	0.64 (0.47,0.88)	0.005	163	0.60 (0.47,0.78)	0.0001
African American (N = 354)	61	1.01 (0.67,1.52)	0.98	155	1.01 (0.75,1.34)	0.97
Other (N = 248)	32	0.87 (0.51,1.49)	0.62	107	0.77 (0.56,1.05)	0.10
Age (Years) (N = 6,879)	1,625	1.00 (0.99,1.02)	0.85	2,369	0.98 (0.97,0.99)	0.001
Maximum Education Obtained (Years) (N = 6,836)	1,617	1.04 (1.00,1.08)	0.04	2,354	1.03 (1.00,1.06)	0.10
Comorbidities***						
Heart Disease (N =1,032)	382	1.37 (1.13,1.65)	0.001	266	1.18 (0.94,1.49)	0.16
Hypertension (N = 3,266)	819	1.16 (1.00,1.35)	0.06	1,141	1.16 (1.00,1.33)	0.04
Diabetes (N = 1,106)	314	1.15 (0.94,1.40)	0.18	346	1.00 (0.82,1.22)	1.00
Lung Disease, COPD, or Asthma (N = 821)	179	1.25 (0.98,1.61)	0.08	335	1.12 (0.92,1.36)	0.26
Kidney Disease (N = 339)	100	1.16 (0.83,1.62)	0.40	123	1.49 (1.05,2.11)	0.03
Diagnosed w/ Cancer in past 5 yrs. (N = 920)	268	1.04 (0.85,1.27)	0.73	305	1.51 (1.21,1.88)	0.0003

*Adjusted for the other variables in the table.
*Male (Reference) vs. Female: OR = 1.43 (95% CI: 1.29,1.58; p<.0001)
**Reference is White
***Reference is “no comorbidity”

4.11 Risk of Postponing Any Surgical Procedure(s) Due to the COVID-19 Pandemic by Sex, Race/Ethnicity, Age, Education, and Co-morbidity

Compared to White men, Japanese American men were 42% (95% CI: 0.40, 0.84; p=0.0033) less likely to postpone any surgical procedure(s) due to the COVID-19 pandemic. Compared to White women, Japanese American women were 32% (95% CI: 0.50, 0.94; p=0.02) and Native Hawaiian women 72% (95% CI: 0.14, 0.59; p=0.0008) less likely to postpone any surgical procedure(s) due to the COVID-19 pandemic.

Men with more education obtained were 9% more likely per year of education (95% CI: 1.00, 1.18; p=0.05) to postpone any surgical procedure(s). The comparison between men and women, with men as the reference group, was not significant (p=0.26).

Compared with men with no comorbidity, men with heart disease were 44% (95% CI: 1.01, 2.04; p=0.04) and those diagnosed with cancer in the past 5 years 44% (95% CI: 1.00, 2.08; p=0.05) more likely to postpone any surgical procedure(s). Compared with women with no comorbidity, women with hypertension were 72% (95% CI: 1.30, 2.29; p=0.0002), those with lung disease, COPD or asthma 43% (95% CI: 1.01, 2.02; p=0.04), those with kidney disease 76% (95% CI: 1.06, 2.91; p=0.03) and those diagnosed with cancer in the past 5 years 65% (95% CI: 1.17, 2.35; p=0.0049), more likely to postpone any surgical procedure(s).

Table 4.11 Odds Ratio* for Postponing Surgical Procedures Due to COVID-19 Pandemic by Demographics and Comorbidities

	Male (N = 2,996)			Female (N = 3,876)		
	Yes (n)	Odds Ratio (95% CI)	P-Value	Yes (n)	Odds Ratio (95% CI)	P-Value
Ethnicity**						
White (N = 3,026)	115	1		127	1	
Japanese American (N = 2,224)	48	0.58 (0.40,0.84)	0.003	64	0.68 (0.50,0.94)	0.02
Native Hawaiian (N = 507)	9	0.63 (0.31,1.28)	0.20	9	0.28 (0.14,0.59)	0.001
African American (N = 354)	9	1.14 (0.55,2.36)	0.72	19	0.91 (0.54,1.53)	0.71
Latino (N = 515)	11	0.68 (0.35,1.31)	0.24	15	0.75 (0.42,1.34)	0.33
Other (N = 246)	0	<0.001 (<0.001,>999.999)	0.98	10	0.62 (0.32,1.22)	0.17
Age (Years) (N = 6,872)	192	1.01 (0.98,1.04)	0.38	244	0.99 (0.96,1.02)	0.48
Maximum Education Obtained (Years) (N = 6,829)	187	1.09 (1.00,1.18)	0.05	244	1.06 (0.99,1.13)	0.09
Comorbidities***						
Heart Disease (N = 1,032)	53	1.44 (1.01,2.04)	0.04	37	1.26 (0.85,1.86)	0.25
Hypertension (N = 3,262)	98	1.09 (0.80,1.50)	0.58	144	1.72 (1.30,2.29)	0.0002
Diabetes (N = 1,104)	34	1.03 (0.68,1.56)	0.89	43	1.09 (0.75,1.59)	0.64
Lung Disease, COPD, or Asthma (N = 818)	25	1.19 (0.75,1.89)	0.46	45	1.43 (1.01,2.02)	0.04
Kidney Disease (N = 339)	13	1.15 (0.62,2.12)	0.66	21	1.76 (1.06,2.91)	0.03
Diagnosed w/ Cancer in past 5 yrs. (N = 919)	45	1.44 (1.00,2.08)	0.05	44	1.65 (1.17,2.35)	0.005

*Adjusted for the other variables in the table.
*Male (Reference) vs. Female: OR = 1.13 (95% CI: 0.92,1.38; p=0.26)
**Reference is White
***Reference is “no comorbidity”

4.12 Risk of Postponing Any Cancer Screening Test/Procedure Due to the COVID-19 Pandemic by Sex, Race/Ethnicity, Age, Education, and Co-morbidity

Compared to White men, Japanese American men were 72% (95% CI: 0.18, 0,45; p<.0001) less likely to postpone any cancer screening test/procedure due to the COVID-19 pandemic. Compared to White women, Japanese American women were 40% (95% CI: 0.46, 0.78; p=0.0002) less likely to postpone any cancer screening test/procedure due to the COVID-19 pandemic.

Older women were 4% less likely per year of age (95% CI: 0.94, 0.98; p=0.001) to postpone any cancer screening test/procedure. Women with more education obtained were 10% more likely per year of education (95% CI: 1.05, 1.16; p=0.0004) to postpone any cancer screening test/procedure. Compared to men, women were 137% (95% CI: 1.95, 2.88; p<.0001) more likely to postpone any cancer screening test/procedure.

Compared to men with no comorbidity, men diagnosed with cancer in the past 5 years were 254% (95% CI: 2.52, 4.95; p<.0001) more likely to postpone any cancer screening test/procedure. Compared to women with no comorbidity, women with lung disease, COPD, or asthma were 50% (95% CI: 1.14, 1.98; p=0.0036) and those diagnosed with cancer in the past 5 years were 222% (95% CI: 2.50, 4.14; p<.0001) more likely to postpone any cancer screening test/procedure.

Table 4.12 Odds Ratio* for Postponing Cancer Screening Test/Procedure Due to COVID-19 Pandemic by Demographics and Comorbidities

	Male (N = 2,988)			Female (N = 3,866)		
	Yes (n)	Odds Ratio (95% CI)	P-Value	Yes (n)	Odds Ratio (95% CI)	P-Value
Ethnicity**						
White (N = 3,018)	123	1		227	1	
Japanese American (N = 2,220)	23	0.28 (0.18,0.45)	<.0001	90	0.60 (0.46,0.78)	0.0002
Native Hawaiian (N = 508)	7	0.48 (0.21,1.05)	0.07	32	0.73 (0.48,1.11)	0.14
African American (N = 353)	7	0.90 (0.40,2.03)	0.81	27	1.01 (0.65,1.57)	0.96
Latino (N = 509)	8	0.48 (0.23,1.03)	0.06	25	0.90 (0.57,1.44)	0.66
Other	1	0.24 (0.03,1.80)	0.17	21	0.86 (0.53,1.41)	0.55
Age (Years) (N = 6,854)	169	0.96 (0.93,1.00)	0.06	422	0.96 (0.94,0.98)	0.001
Maximum Education Obtained (Years) (N = 6,811)	166	1.03 (0.95,1.12)	0.50	421	1.10 (1.05,1.16)	0.0004
Comorbidities***						
Heart Disease (N = 1,028)	29	0.82 (0.53,1.27)	0.37	52	1.21 (0.87,1.69)	0.27
Hypertension (N = 3,255)	75	1.07 (0.76,1.50)	0.70	195	1.07 (0.86,1.34)	0.56
Diabetes (N = 1,099)	22	0.88 (0.54,1.44)	0.61	53	0.83 (0.59,1.16)	0.27
Lung Disease, COPD, or Asthma (N = 815)	17	0.84 (0.48,1.47)	0.54	79	1.50 (1.14,1.98)	0.004
Kidney Disease (N = 337)	7	0.89 (0.40,2.00)	0.78	18	0.94 (0.55,1.58)	0.80
Diagnosed w/ Cancer in past 5 yrs. (N = 918)	71	3.54 (2.52,4.95)	<.0001	112	3.22 (2.50,4.14)	<.0001

*Adjusted for the other variables in the table.
*Male (Reference) vs. Female: OR = 2.37 (95% CI: 1.95,2.88; p<.0001)
**Reference is White
***Reference is “no comorbidity”

CHAPTER 5 – DISCUSSION

The results of this study suggest unique relationships between independent variables, such as sex, age, years of education, race/ethnicity, and comorbidities with the likelihood of making changes to lifestyle or daily activities and of postponing regular health care visits, surgical procedures, and cancer screenings/treatments during the COVID-19 pandemic. Responses were compared between males and females and by race/ethnicity to describe the differences between these groups.

African American men (compared to White men), women (compared to men), men and women with more education, men and women with heart disease, hypertension, or lung disease, COPD, or asthma (compared to men or women with no comorbidity) were more likely to make changes to their lifestyle or daily activities during the COVID-19 pandemic. Men with more education, women (compared to men), men with heart disease, and women with hypertension, kidney disease, and diagnosed with cancer in the past 5 years were more likely to postpone regular health care visits during the COVID-19 pandemic. Men with more education, men with heart disease and those diagnosed with cancer in the past 5 years, and women with hypertension, lung disease, COPD or asthma, kidney disease, and those diagnosed with cancer in the past 5 years were more likely to postpone surgical procedures during the COVID-19 pandemic. Lastly, women with more education obtained, women (compared to men), men diagnosed with cancer in the past 5 years, and women with lung disease, COPD, or asthma and those diagnosed with cancer in the past 5 years were more likely to postpone any cancer screening test/procedure due to the COVID-19 pandemic.

Native Hawaiian men and women and those of Other race/ethnicity (compared to White men or women), and older men and women were less likely to make changes to their lifestyle or daily activities during the COVID-19 pandemic. Latino and Native Hawaiian men, Native Hawaiian women, and older women were less likely to postpone regular health care visits during the COVID-19 pandemic. Japanese American men and women and Native Hawaiian women were less likely to postpone any surgical procedure(s) during the COVID-19 pandemic. Lastly, Japanese American men and women and older women were less likely to postpone any cancer screening test/procedure during the COVID-19 pandemic.

5.1 Effect on Healthcare Visits

From May 2020 to September 2020, 54.2% of male and 61.3% of female survey respondents reported postponing regular health care visits. These numbers are consistent with a report published by The Commonwealth Fund in May 2020.[20] In the U.S., early in the pandemic, the number of visits to ambulatory care practice declined by nearly 60%. Declines in visits varied by geographic area and clinical specialty. Since then, a rebound of in-person visits has occurred and appears largest in the South Central (East and West) census division (Texas, Oklahoma, Arkansas, Louisiana, Mississippi, Alabama, Tennessee, and Kentucky) but the number of visits is still roughly one-third lower than what was seen before the pandemic. As in-person visits declined, telehealth visits increased rapidly before plateauing. Rebound in visits has occurred across all specialties. But the relative decline in visits remains largest among surgical and procedural specialties and pediatrics. The effect on surgical and procedural specialties was observed in the MEC survey responses, as visits with eye specialists,

dermatologists, cardiologists, and dentists, were more often reported to be postponed. Since the MEC study population was elderly, the postponement of pediatrics was not observed. For the Commonwealth Fund study, the relative decline was smaller in other specialties, such as adult primary care, which disagrees with the MEC study findings as visits for this specialty was the most frequently postponed in the data. Although the COVID-19 pandemic led to widespread disruptions in medical care, it is possible that patients who avoided hospital visits had a positive outcome of lower risk of catching COVID-19. There may have been some benefit to the strategy of keeping patients out of the hospitals and physician offices. From the baseline MEC Survey, only 49 men and 68 women, overall, reported an episode of COVID-19. These numbers are not definitive as low testing rates at the beginning of the pandemic and the low response rates of the survey allow for missing cases.

The likelihood of postponing healthcare visits being related to the presence of comorbidities was also analyzed. In the MEC Study, men with heart disease (by 37%), women with hypertension (by 16%), kidney disease (by 49%), and those diagnosed with cancer in the past 5 years (by 51%) were more likely to postpone regular health care visits due to the COVID-19 pandemic. These findings were consistent with a study that examined factors associated with postponed health checkups during the COVID-19 pandemic in Germany.[45] Researchers found the probability of postponed health checkups was positively associated with the presence of chronic disease (OR: 1.68, 95% CI: 1.15, 2.47), higher affect concerning a COVID-19 infection (higher values corresponded to higher affect regarding COVID-19, OR: 1.44, 95% CI: 1.16, 1.78), and higher presumed severity of COVID-19 (OR: 1.17, 95% CI: 1.01, 1.35).

5.2 Effect on Surgical Procedures

The survey respondents did not report a large percentage of postponement of surgical procedures. Only 6.4% of men and 6.3% of women had to postpone a surgical procedure due to COVID-19. These numbers contrasted with a study on trends in U.S. surgical procedures during the COVID-19 pandemic.[46] In a cohort study of more than 13 million U.S. surgical procedures from January 1, 2019, through January 30, 2021, there was a 48.0% decrease in total surgical procedure volume immediately after the March 2020 recommendation to cancel elective surgical procedures. Surgical volume returned to 2019 rates in all surgical specialties except otolaryngology, a rate maintained during the COVID-19 peak surge in fall and winter. In the United Kingdom, a retrospective analysis was conducted on the changing trend in capacity and workload of the ophthalmology service at a single medical center between June 1, 2019 (pre-COVID) and June 31, 2020 (during the COVID-19 pandemic).[47] A substantial 63% and 67% reduction in outpatient and surgical activities was observed when comparing June 2019 with 2020. Cataract surgery (53%) formed the majority of the surgical backlog. These findings are consistent with the results from the MEC COVID survey as the type of surgical procedure that had the highest number of postponements was eye surgery, which included procedures to treat glaucoma, cataract, and retinal damage. Additionally, there was a significant ~1800% increase in the number of virtual or teleconsultation visits ($p < 0.0001$). The use of telehealth for regular and surgical consultation appointments wasn't surveyed in the MEC COVID study but the information would be interesting to know in future studies.

5.3 Effect on Cancer Screenings

The survey respondents did not report a large percentage of postponing cancer screenings. Only 5.7% of men and 11.0% of women had to postpone any cancer screening or procedure due to COVID-19. These numbers were not as expected but could be explained by the older age of the sample that was obtained. The recommended cut-off age for breast and colorectal cancer screening is 74 and 75 years old. Half of the respondents were aged 75 and older. However, when stratifying the responses by 75 years and younger, the numbers were similar to the overall sample size: 6.1% vs. 5.7% of men overall and 12.3% vs. 11.0% of women overall. The screening procedure the most frequently missed was mammography, followed by skin examination and colorectal cancer screening. Postponement of these cancer screening categories is consistent with data from a different study looking at a sample of health claims clearinghouse records from 18 states containing 184 million claims from 30 million patients in 2019 and 94 million claims from 20 million patients for the first 6 months in 2020.[48] Mammograms and Pap smears were down nearly 80 percent in April 2020 compared to 2019. However, both services recovered throughout the summer and fall, with Pap smears and mammograms rebounding above 2019 levels in August 2020 and November 2020, respectively. Colonoscopies were down almost 90% in mid-April 2020, compared to 2019, and in December 2020 were still down about 15% compared to the previous year, representing a substantial but incomplete rebound in care delivered. The overall number of colonoscopies performed in 2020 declined by almost 25% from 2019.

The likelihood of postponing cancer screenings being related to age was also analyzed. In the MEC study, older women were 4% per year of age less likely to postpone any cancer screening test/procedure. This finding was consistent with a study examining determinants of postponed cancer screening during the COVID-19 pandemic in Germany.[49] Multiple logistic regressions were conducted with postponed cancer screenings since March 2020 due to the COVID-19 pandemic as the outcome measure (0= no, attended as planned, 1 = postponed). Regressions revealed that the likelihood of postponing cancer screening was positively associated or more likely with higher affect concerning a COVID-19 infection (higher values correspond to higher affect regarding COVID-19, OR: 1.65, 95% CI: 1.16, 2.35), whereas it was negatively associated or less likely with older age (e.g., 65 years and over, OR: 0.38, 95% CI: 0.16, 0.89, compared to individuals 30 to 49 years).

The backlog of postponed or delayed cancer screenings will have a long-term clinical impact and increase the cancer burden. A study from Canada examined the impact of episodic screening interruptions for breast and colorectal cancer.[50] Using a simulation model, researchers projected a surge of cancer cases when screening resumes. For breast cancer screening, the simulation model suggests that a three-month interruption of breast cancer screening due to COVID-19 would result in 644,000 fewer screens performed in Canada in 2020. A three-month interruption starting in 2020 could increase cases diagnosed at advanced stages (310 more) and breast cancer deaths (110 more) in Canada from 2020 to 2029. A six-month interruption starting in 2020 could lead to 670 extra advanced breast cancers and 250 additional breast cancer deaths in Canada from 2020 to 2029. For colorectal cancers, without service

interruption, the simulation model estimated that 68,000 colonoscopies would have been performed in the six months since March 2020 in Canada. A six-month suspension of primary screening could increase cancer incidence by 2,200 cases with 960 more cancer deaths over the lifetime. Longer interruptions, and reduced volumes of patients when screening resumes, would further increase excess cancer deaths.

5.4 Effect on Mental Health and Sleep

Compared to before COVID-19, 88.5% and 3.3% of men, reported their quality of sleep during the past two weeks had been as good and better, respectively. The corresponding %'s for women were 83.8 and 3.9%. While 8.3% of men and 12.3% of women reported their sleep quality had worsened. These finding from the MEC COVID study is consistent with a longitudinal, cross-sectional study examining sleep health early in the COVID-19 pandemic in the United States.[51] Researchers studied adult participants in late March 2020 and found that relative to baseline data from mid-February 2020, cross-sectional and demonstrated that average sleep quality was unchanged, or even improved, early in the pandemic. However, there were clear individual differences as approximately 25% of participants reported that their sleep quality had worsened, which was explained by stress vulnerability, caregiving, adverse life impact, shift work, and presence of COVID-19 symptoms. A separate study in Italy also found results consistent with the MEC COVID study findings.[52] Over the past two weeks, 51.5% of male participants and 62.5% of female participants in the MEC COVID-19 study reported having trouble getting to sleep or staying asleep. While the study from Italy found similar findings of 42% of participants having sleep disturbances and among them 17.4% reported moderate/severe insomnia. In regard to mental health,

21.9% and 16.4% of male participants and 34.1% and 24.8% of female participants in the MEC COVID-19 study reported feeling nervous, anxious, or on edge and feeling down, depressed, or hopeless, respectively. While the study from Italy reported anxiety and depression prevalence of 23.2% and 24.7%.

5.5 Limitations

There are several limitations to our study. Although our study population is diverse, some subgroups of race/ethnicity (African Americans and Latinos) have a smaller sample size compared to other subgroups. Additionally, the study sample is not representative of the entire MEC cohort, as the participants were more educated with higher percentages with at least some college education across all races/ethnicities. The survey respondents included a larger representation of Whites and Japanese Americans and a smaller representation of Latinos and African Americans compared to the MEC survivors in 2019. The data was self-reported so there is a chance of misclassification due to measurement error. A few participants misunderstood certain questions leading to answers that were not as expected so it would've been helpful to recontact participants directly to clarify. However, since the sample size is large, it would be labor-intensive. Lastly, the response rates were low across all races/ethnicities and only 0.9% of male and 1.7% of female participants are living in a retirement or care home so these populations are underrepresented.

5.6 Future Directions

From this work, we learned that online surveys are possible in the MEC but due to the older age structure of the cohort, participation is limited, especially among African Americans and Latinos. This online survey methodology can be applied to future studies

but would be best limited to a younger age group. A question was asked at the end of the survey regarding re-contacting the participant for testing blood antibodies to the COVID-19 virus: 85.52% of men and 83.55% of women said they were willing to participate. Since we will be identifying cancer diagnoses and deaths through linkages to cancer registries in HI and California, we will be able to examine whether a greater proportion of cancers are diagnosed at a late stage in the aftermath of the pandemic and investigate any differences among ethnic/racial groups. Similarly, through linkage of the cohort to Medicare, we will be able to identify MEC members who developed COVID-19 and investigate long-term complications and survival across age and race. The statistical analysis conducted for this thesis did not stratify participants by location (e.g., HI vs Los Angeles) as our main interest was to compare baseline information by race/ethnicity (which correlates with the study site). This analysis can be conducted in future studies as each participant's location was recorded using AREA ID and the results may be insightful as HI and Los Angeles experienced different waves and peaks of COVID-19 cases during the four months that the baseline survey responses were collected.

CHAPTER 6 – CONCLUSION

The MEC COVID-19 survey demonstrated the possibility of using a mature cohort study of well-characterized individuals to characterize the effect of a public health emergency. The study revealed associations of factors like sex, race/ethnicity, age, education level, comorbidities, and healthcare decisions of MEC participants made during the COVID-19 pandemic in Hawai‘i and Los Angeles. The MEC COVID-19 survey results were consistent with other studies regarding the postponement of health care visits, surgical procedures, and cancer screenings, and mental health and sleep during the pandemic. Increased monitoring of patients in high-risk groups for cancer and other diseases is of the utmost importance as the chance of undiagnosed cases and poor prognosis due to delayed screening and medical care increases.

APPENDICES

APPENDIX A. Supplementary Tables

Supplementary Table A.1 Response Rates (%) by Sex and Ethnicity

		Male	Female
		7.2	6.3
Race/Ethnicity	White	13.2	12.0
	Japanese American	8.9	7.4
	Latino	2.2	2.0
	Native Hawaiian	7.3	7.5
	African American	2.7	2.8
	Other	2.7	4.5

Supplementary Table A.2 Distribution of Residential Conditions, Hawai'i and Los Angeles (N = 6,974)

Residence:	**N (%)**	
I live…	**Male**	**Female**
By self	511 (17.0)	1,296 (33.4)
Spouse	2,337 (77.9)	1,953 (50.4)
Relatives	124 (4.1)	561 (14.5)
Retirement/care home	28 (0.9)	66 (1.7)
Missing	34	63
Type of dwelling:		
Detached	2,317 (77.3)	2,786 (71.8)
Townhouse	171 (5.7)	227 (5.9)
Low rise	136 (4.5)	229 (5.9)
High rise	244 (8.1)	336 (8.7)
Other	131 (4.4)	303 (7.8)
Missing	35	59
Elevator Usage at Residence	281 (9.3)	409 (10.5)
Missing	35	61

Supplementary Table A.3 Distribution of Baseline COVID Survey Participants by Health Status, Comorbidities, and Medication Use, Hawai'i and Los Angeles (N = 6,974) (Continued on next page)

	Male N (%)	Female N (%)
Health Status:		
Has Health Problems that Require Them to Stay at Home	104 (3.5)	189 (4.9)
Missing	35	64
	.	
Needs Assistance with Daily Living Activities on a Regular Basis	96 (3.2)	156 (4.0)
Missing	35	61
Cane, Walker, or Wheelchair/Scooter Usage to Get About	193 (6.4)	363 (9.4)
Missing	36	57
History of Health Problems that Limit Activities	591 (19.7)	747 (19.3)
Missing	36	62
Comorbidities		
History of Heart Disease	622 (20.8)	412 (10.6)
Missing	38	69
History of Hypertension	1,441 (48.0)	1,824 (47.1)
Missing	37	63
History of Diabetes	548 (18.3)	559 (14.4)
Missing	35	63
History of Lung Disease, COPD, or Asthma	297 (9.9)	523 (13.5)
Missing	37	67
History of Kidney Disease	164 (5.5)	175 (4.5)
Missing	36	65
Diagnosed with Cancer in the Past 5 Years	478 (15.9)	439 (11.3)
Missing	35	62

Supplementary Table A.3 (Continued)

Medication Use		
Taking immunosuppressant medications (including steroids, methotrexate, biologic agents)	110 (3.7)	182 (4.7)
Missing	44	78
Taking heartburn medication Pepcid (famotidine)	307 (10.3)	383 (9.9)
Missing	39	64
Taking Aspirin (baby aspirin or std dose)	1,135 (37.9)	1,091 (28.1)
Missing	36	59
Taking NSAIDs like ibuprofen, nurofen, diclofenac, naproxen	267 (8.9)	418 (10.8)
Missing	35	65
Taking Blood Thinning Medication (such as Coumadin/Warfarin, Eliquis/apixaban)	480 (16.0)	293 (7.6)
Missing	42	75
Taking Blood Pressure Medication ending in -pril (such as enalapril, lisinopril, captopril, ramipril)	771 (25.8)	632 (16.4)
Missing	46	84
Taking Blood Pressure Medication ending in –sartan (such as losartan valsartan, irbesartan)	874 (29.3)	1,004 (26.0)
Missing	46	83

APPENDIX B. Baseline Survey

MEC COVID-19 Baseline Questionnaire

Start of Block: Block 1

1 **Informed Consent Form**
Multiethnic Cohort - COVID-19 Study Principal Investigators: Loïc Le Marchand, MD, PhD and Lynne Wilkens, DrPH (University of Hawai'i); Christopher Haiman, ScD (University of Southern California) **DESCRIPTION:** Because you have been a Multiethnic Cohort (MEC) study participant, you are invited to participate in an online survey to better understand the spread of the COVID-19, identify factors that affect the disease's course, and understand the impact of the COVID-19 virus on all aspects of your life. You will be asked questions about your current health status including symptoms and how COVID-19 has affected you and your household. The MEC and this study are being conducted by researchers at the University of Hawai'i and University of Southern California (https://www.uhcancercenter.org/mec) **TIME INVOLVEMENT:** Your participation in this survey will take about 20 minutes and is completely voluntary. After completing this survey, you will be sent weekly emails to ask you to update your answer about symptoms whether you are sick with COVID-19 or not. This will allow us to track symptoms of infection as they occur in real time in your community. The short weekly survey will take no more than five to ten minutes to complete. **PRIVACY:** This survey is solely for MEC participants and by invitation only. You were sent a private link to begin this online survey. We are not asking you to provide any identifying information in the online survey. The information about your symptoms and general health that you provide in this survey will be linked to the information about you that you have provided to MEC in past mailed questionnaires. **RISKS AND BENEFITS:** The risks associated with this study are minimal and include potential loss of confidentiality and psychological distress due to answering questions about the COVID-19 outbreak. You can skip any question that you do not wish to answer. We cannot and do not guarantee or promise that you will receive any direct benefits from this study, though your responses may be used to improve the community response to the COVID-19 outbreak. **WHAT ARE THE COSTS:** There are no costs to you as a participant. **PAYMENTS/REIMBURSEMENTS:** You will not receive payment for your participation in this study. **PARTICIPANT'S RIGHTS:** If you have read this form and have decided to participate in this project, please understand that your participation is voluntary. You have the right to withdraw your consent or discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled. The results of this research study may be presented at scientific or professional meetings or published in scientific journals. However, your identity will not be disclosed. When analyzing the data, identifiers will be removed from identifiable private information and, after such removal, the information and/or specimens could be used for future studies related to Health/Medical/Biomedical research or distributed to another investigator for future studies related to Health/Medical/Biomedical research without additional informed consent from you. **Authorization To Use Your Health Information For Research Purposes:** Because information about you and your health is personal and private, it generally cannot be used in this research study without your authorization. This form is intended to inform

you about how your health information will be used or disclosed in the study. Your information will only be used in accordance with this informed consent form and as required or allowed by law. Please read it carefully before completing the survey. **What is the purpose of this research study and how will my health information be utilized in the study?** The purpose of this study is to better understand how COVID-19 is impacting your health and day-to-day life. The information you provide will help scientists better understand the symptoms of the disease, the factors that affect its severity, and the general impact on daily life. **Do I have to give my authorization?** You do not have to give your authorization. But if you do not, you will not be able to participate in this study. You may indicate your authorization by completing the survey. **If I give my authorization, can I revoke it or withdraw from the research later?** If you decide to participate, you are free to withdraw your authorization regarding the use of your health information (and to discontinue any other participation in our online surveys for this COVID-19 study) at any time. After any revocation, your health information will no longer be used or disclosed in the study, except to the extent that the law allows us to continue using your information (e.g., necessary to maintain integrity of research). If you wish to revoke your authorization for the research use or disclosure of your health information in this COVID-19 study, you must write to Dr. Loïc Le Marchand at Loic@cc.hawaii.edu or Dr. Christopher Haiman at Christopher.Haiman@med.usc.edu. **What Personal Information Will Be Obtained, Used or Disclosed?** Your health information related to this study may be used or disclosed in connection with this research study, including, but not limited to your current symptoms, receiving or attempting to receive a COVID-19 test, diagnosis with COVID-19, and zip code. Your health information related to this study may be used or disclosed in connection with this research study although any data from this study will only be shared in aggregate with no identifying information attached. **Who May Use or Disclose the Information?** The following parties are authorized to use and/or disclose your health information in connection with this research study: The Principal Investigators (Dr. Loïc Le Marchand, Lynne Wilkens and Christopher Haiman), the University of Hawai‘i and University of Southern California Institutional Review Boards and MEC Study Staff**. Who May Receive or Use the Information?** The parties listed in the preceding paragraph may disclose your health information to the following persons and organizations for their use in connection with this research study: The Office for Human Research Protections in the U.S. Department of Health and Human Services, Food and Drug Administration (FDA), and Center for Disease Control (CDC). Your information may be re-disclosed by the recipients described above, if they are not required by law to protect the privacy of the information. **When will my authorization expire?** Your authorization for the use and/or disclosure of your health information will end on December 31, 2025, or when the research project ends, whichever is earlier. **CONTACT INFORMATION: Questions, Concerns, or Complaints:** If you have any questions, concerns or complaints about this research study, its procedures, risks and benefits, or alternative courses of treatment, you should contact the MEC Study staff at **(808) 586-2996 (Oahu) or 1-877-415-8323 (toll free in Hawai‘i) or 1-800-786-3538 (toll free in California).Independent Contact:** If you are not satisfied with how this study is being conducted, or if you have any concerns, complaints, or general questions about the research or your rights as a participant, please contact the Institutional

Review Board (IRB) of the University of Hawai‘i (Human Studies Program, phone: (808) 956-5007, uhirb@hawaii.edu) or University of Southern California (phone: (323) 442-0114, irb@usc.edu). **If you agree to participate in this research, please complete the survey.**

- ○ Yes
- ○ No

Skip To: 2 If Informed Consent Form Multiethnic Cohort - COVID-19 Study Principal Investigators: Loïc Le Marcha... = Yes

Skip To: End of Survey If Informed Consent Form Multiethnic Cohort - COVID-19 Study Principal Investigators: Loïc Le Marcha... = No

2 What year were you born? (i.e. 1935)

_____

3 What sex were you assigned at birth?

- ○ Male
- ○ Female
- ○ Prefer not to say

4 Your height? (in inches)

_____

5 Your weight? (in pounds)

_____

6 Your zip code?

_____

7 I live ...

- ○ By myself
- ○ With a spouse or significant other, possibly with others
- ○ With other relatives
- ○ In a retirement or care home

8 What type of dwelling is your residence?

- ○ Detached house
- ○ Townhouse
- ○ Low rise apartment (1-3 floors)
- ○ High rise apartment (>3 floors)
- ○ Other (Please specify)

_____

9 Do you generally use an elevator to get to your residence?

- ○ No
- ○ Yes

10 In general, do you have any health problems that require you to stay at home?

- ○ No
- ○ Yes

11 Do you need someone to help you with daily living activities on a regular basis?

- ○ No
- ○ Yes

12 If you need help, can you count on someone close to you?

- ○ No
- ○ Yes

13 Do you regularly use a cane, walker or wheelchair/scooter to get about?

- ○ No
- ○ Yes

14 In general, do you have any health problems that require you to limit your activities?

- ○ No
- ○ Yes

15 Do you have heart disease?

- ○ No
- ○ Yes

16 Do you have high blood pressure (hypertension)?

- ○ No
- ○ Yes

17 Do you have diabetes?

- ○ No
- ○ Yes

18 Do you have lung disease, COPD (chronic obstructive pulmonary disease) or asthma?

- ○ No
- ○ Yes

19 Do you smoke?

- ○ Never
- ○ Not currently, but in the past
- ○ Yes

Display This Question:

If Do you smoke? = Not currently, but in the past

20 How many years since you last smoked?

_____

21 Do you have kidney disease?

- ○ No
- ○ Yes

22 Have you been diagnosed with cancer in the past five years?

- ○ No
- ○ Yes

23 Have you ever had a Flu vaccination?

- ○ No
- ○ Yes

Display This Question:

If Have you ever had a Flu vaccination? = Yes

24 When was the last time you had a Flu vaccination? Month / Year of vaccine:
For example: 08/2019

_____

25 Do you regularly take immunosuppressant medications (including steroids, methotrexate, biologic agents)?

- No
- Yes

26 Do you regularly take the heartburn medication Pepcid (famotidine)?

- No
- Yes

27 Do you regularly take aspirin (baby aspirin or standard dose)?

- No
- Yes

28 Do you regularly take NSAIDs like ibuprofen, nurofen, diclofenac, naproxen?

- No
- Yes

29 Are you on blood thinning medication (such as Coumadin/Warfarin, Eliquis/Apixaban)?

- No
- Yes

30 Are you regularly taking blood pressure medications ending in -pril (such as enalapril, lisinopril, captopril, ramipril)?

- ○ No
- ○ Yes

---

31 Are you regularly taking blood pressure medications ending in -sartan, such as losartan, valsartan, irbesartan?

- ○ No
- ○ Yes

---

32 Have you made any changes to your lifestyle or daily activities since the COVID-19 pandemic?

- ○ No, I have not changed my lifestyle or daily activities; I am doing everything I normally do
- ○ Yes, I have made some changes to my lifestyle or daily activities

---

33 Which of the following are you doing? (Select all that apply):

- ☐ Effectively covering a cough or sneeze
- ☐ More frequent hand washing
- ☐ Washing hands for a longer period of time or more vigorously
- ☐ More use of hand sanitizer
- ☐ More frequent disinfecting of surfaces
- ☐ Keeping at least 6 feet away from others
- ☐ Avoiding social gatherings
- ☐ Not attending classes
- ☐ Avoiding gym and exercise classes
- ☐ Avoiding going to the doctor or dentist for routine appointments
- ☐ Working from home
- ☐ Avoiding or canceling domestic travel
- ☐ Avoiding or canceling international travel
- ☐ Stocking up on food and supplies
- ☐ Other (Please specify):

_____

- ☐ No changes because of COVID-19 pandemic

End of Block: Block 1

Start of Block: Block 2

Experts and government agencies have advised the public to stay home except to perform essential tasks in some areas.

34 To what extent are you able to stay at home to prevent the spread of coronavirus?

- ○ I am staying at home nearly all the time
- ○ Most of the time. I only leave my home to buy food and other essentials, for essential travel, or for other essential activities
- ○ Some of the time. I have reduced my time in public spaces, social gatherings, or at work
- ○ None of the time. I am doing everything I normally did before coronavirus

35 How many times have you left the place you are staying within the last 7 days?

_____

36 Why have you left your house or the place where you are staying (select all that apply)?

- [ ] Work
- [ ] Medical care (Doctor appointment, dental appointment)
- [ ] Grocery store
- [ ] Picking up mail or packages
- [ ] Pet or animal care, including walking a dog
- [ ] Outdoor exercise
- [ ] Volunteer work
- [ ] Donating blood
- [ ] Pick up food from restaurants
- [ ] Drugstore (Walgreens, CVS, Longs, etc.)
- [ ] Walmart, Target, Costco, other large stores
- [ ] Someone else's house or residence
- [ ] Restaurant or bar
- [ ] Care for an elderly family member or friend
- [ ] Other (please specify): _____
- [ ] I have not left the place where I am staying

37 Have you EVER been exposed to someone with documented or presumed COVID-19 infection (such as co-workers, family members, or others)? Please check all that apply.

- ☐ Yes, documented COVID-19 case
- ☐ Yes, presumed COVID-19 cases
- ☐ Not that I know of

38 Do you think you have already had COVID-19, but were not tested?

- ○ No
- ○ Yes
- ○ Not sure

Display This Question:
If Do you think you have already had COVID-19, but were not tested? = Yes

39 Did you have the classic symptoms (high fever and persistent cough) for several days?

- ○ No
- ○ Yes

Display This Question:
If Do you think you have already had COVID-19, but were not tested? = Yes

40 How many days ago did your symptoms start?

_____

41 Have you ever had a test for COVID-19?

- ○ No
- ○ Yes

Display This Question:

If Have you ever had a test for COVID-19? = Yes

42 When were you tested (Month / Day / Year)?
Ex.: 03/20/2020

_____

Display This Question:

If Have you ever had a test for COVID-19? = Yes

43 Did you test positive for COVID-19 on this test?

- ○ Yes
- ○ No
- ○ Waiting for results

Display This Question:

If Did you test positive for COVID-19 on this test? = Yes

44 When did you last test positive for COVID-19?

- ○ I have never tested positive
- ○ I last tested positive on (Month/Day/Year). Ex. 03/11/2020

_____

45 How do you feel physically right now?

- ○ I feel physically normal
- ○ I'm not feeling quite right

46 Do you have a fever?

- ○ No
- ○ Yes

Display This Question:

If Do you have a fever? = Yes

47 If you are able to measure it, what is your temperature?

_____

48 Do you have a persistent cough (coughing a lot for more than an hour, or 3 or more coughing episodes in 24 hours)?

- No
- Yes

49 Are you experiencing unusual fatigue?

- No
- Mild Fatigue
- Severe fatigue - I struggle to get out of bed

50 Do you have a headache?

- No
- Yes

51 Are you experiencing unusual shortness of breath?

- No
- Yes. Mild symptoms - slight shortness of breath during ordinary activity.
- Yes. Significant symptoms - breathing is comfortable only at rest.
- Yes. Severe symptoms - breathing is difficult even at rest.

52 Do you have a sore throat?

- ○ No
- ○ Yes

53 Do you have loss of smell/taste?

- ○ No
- ○ Yes

54 Do you have an unusually hoarse voice?

- ○ No
- ○ Yes

55 Are you feeling unusual chest pain or tightness in your chest?

- ○ No
- ○ Yes

56 Do you have unusual abdominal pain?

- ○ No
- ○ Yes

57 Are you experiencing diarrhea?

- ○ No
- ○ Yes

58 Are you experiencing nausea?

- ○ No
- ○ Yes

59 Have you been skipping meals?

- ○ No
- ○ Yes

60 Are there any other important symptoms you want to share with us?

_____

_____

_____

_____

_____

61 Where are you right now?

- ○ I'm at home. I have not been to the clinic or hospital for suspected COVID symptoms
- ○ I am in the clinic or hospital with suspected COVID symptoms
- ○ I am back from the clinic or hospital, I'd like to tell you about my treatment
- ○ I am back from the clinic or hospital, I've already told you about my treatment

Display This Question:

If Where are you right now? = I am in the clinic or hospital with suspected COVID symptoms

Or Where are you right now? = I am back from the clinic or hospital, I'd like to tell you about my treatment

62 What treatment did you receive or are you receiving right now?

- ○ None
- ○ Oxygen and fluids* (*Breathing support through an oxygen mask, no pressure applied)
- ○ Non-invasive ventilation* (*Breathing support through an oxygen mask, which pushes oxygen into your lungs)
- ○ Invasive ventilation* (*Breathing support through an inserted tube. People are usually asleep for this procedure)
- ○ Other (Please specify)
  _____

End of Block: Block 2

Start of Block: Block 3

How concerned are you about the following:

63 Me or someone in my family getting sick from coronavirus?

- ○ Not at all concerned
- ○ A little concerned
- ○ Moderately concerned
- ○ Very concerned
- ○ Extremely Concerned

64 Not being able to get medical care?

- Not at all concerned
- A little concerned
- Moderately concerned
- Very concerned
- Extremely Concerned

65 Not being able to take care of family members if I get sick?

- Not at all concerned
- A little concerned
- Moderately concerned
- Very concerned
- Extremely Concerned

66 Not being able to obtain food, supplies, or medicine?

- Not at all concerned
- A little concerned
- Moderately concerned
- Very concerned
- Extremely Concerned

67 Investment or retirement savings going down?

- Not at all concerned
- A little concerned
- Moderately concerned
- Very concerned
- Extremely Concerned

End of Block: Block 3

Start of Block: Block 4

68 On the average, over the past two weeks, how many hours in a day did you sleep (include naps)

- 5 or less
- 6
- 7
- 8
- 9
- 10 or more

69 Over the past two weeks, how often did you have trouble getting to sleep or staying asleep?

- Not in past 2 weeks
- Less than once a week
- 1 or 2 times a week
- 3 or more times a week

70 Over the past two weeks, how would you rate your sleep quality overall?

- ○ Very good
- ○ Fairly good
- ○ Fairly bad
- ○ Very bad

71 Compared to before COVID-19, would you say the quality of your sleep during the past two weeks has been:

- ○ Better
- ○ As good
- ○ Somewhat worse
- ○ Much worse

End of Block: Block 4

Start of Block: Block 6

Over the last 2 weeks, how often have you been bothered by the following problems?

72 Feeling nervous, anxious, or on edge

- ○ Not at all
- ○ Several days
- ○ More than half the days
- ○ Nearly every day

73 Not being able to stop or control worrying

- Not at all
- Several days
- More than half the days
- Nearly every day

74 Little interest or pleasure in doing things

- Not at all
- Several days
- More than half the days
- Nearly every day

75 Feeling down, depressed, or hopeless

- Not at all
- Several days
- More than half the days
- Nearly every day

End of Block: Block 6

Start of Block: Block 5

76 In the past 2 weeks, how many days have you had a drink of an alcoholic beverage?

_____

77 In the past 2 weeks, how many days did you have 5 or more drinks on the same occasion?

_____

78 How has your drinking behavior changed during the COVID-19 pandemic?

- ○ You have not drunk any alcohol
- ○ You have drunk more (e.g., greater frequencies or more drinks on the same occasion) during the COVID-19 pandemic
- ○ You have drunk less (e.g., less frequencies or less drinks on the same occasion) during the COVID-19 pandemic
- ○ Your drinking behavior remains the same during the COVID-19 pandemic

79 How many people live in your household, including yourself?

_____

80 How many children under the age of 18 live in your household?

_____

81 How many adults 65 years or older live in your household, including yourself?

_____

82 How many people in your household have been diagnosed with the novel coronavirus COVID-19?

_____

83 How many people in your household have been having symptoms related to coronavirus COVID-19, including yourself?

_____

84 Has your household income decreased since the start of the coronavirus COVID-19 pandemic on March 11, 2020?

- ○ No
- ○ Yes, a little
- ○ Yes, a lot
- ○ Don't know / Not sure

---

85 Have you provided financial support to family members or friends due to the difficulties caused by the coronavirus COVID-19 pandemic?

- ○ No
- ○ Yes

---

86 How hard is it for you to pay for the basics like food, housing, medical care, and utilities (such as for air-conditioning/heating) since the COVID-19 pandemic?

- ○ Not hard at all
- ○ Somewhat hard
- ○ Very hard
- ○ Don't know / Not sure

---

87 Since the COVID-19 pandemic began, have you or any family members you live with been unable to get or pay for something when it was really needed?

- ○ No
- ○ Yes

Display This Question:

If Since the COVID-19 pandemic began, have you or any family members you live with been unable to ge... = Yes

88 Which of the following were you or your family member unable to get? Select all that apply.

- [ ] Food
- [ ] Clothing
- [ ] Utilities
- [ ] Child Care
- [ ] Medicine or any health care (medical, dental, mental health)
- [ ] Housing
- [ ] Other (Please specify): _____

89 Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, government plans such as Medicare or Medicaid, or Indian Health Service?

- ○ No
- ○ Yes
- ○ I don't know / Not sure

90 Do you have a primary care provider or a family physician that you see for routine check-ups?

- ○ No
- ○ Yes

91 Since March 20, 2020, have you had to postpone any of your regular health care visits due to the COVID-19 pandemic?

- ○ No
- ○ Yes

Display This Question:

If Since March 20, 2020, have you had to postpone any of your regular health care visits due to the... = Yes

92 What type of health care provider was that (select all that apply)?

- ☐ My primary care physician
- ☐ My oncologist
- ☐ My cardiologist
- ☐ My endocrinologist
- ☐ Other specialist (specify): _____
- ☐ My dentist
- ☐ Other health care provider (specify): _____

93 Since March 20, 2020, have you had to postpone any surgical procedure(s) due to the COVID-19 pandemic?

- ○ No
- ○ Yes

Display This Question:

If Since March 20, 2020, have you had to postpone any surgical procedure(s) due to the COVID-19 pand... = Yes

94 What type of surgery was that (specify)?

_____

95 Since March 20, 2020, have you had to postpone any cancer screening test/procedure due to the COVID-19 pandemic?

- ○ No
- ○ Yes

Display This Question:

If Since March 20, 2020, have you had to postpone any cancer screening test/procedure due to the COV... = Yes

96 What type of screening test/procedure was that (select all that apply)?

- ☐ Breast cancer screening (e.g., mammography, breast MRI)
- ☐ Colorectal cancer screening (e.g., FOBT test, FIT test, colonoscopy, sigmoidoscopy)
- ☐ Skin cancer screening (e.g., skin exam)
- ☐ Prostate cancer screening (digital rectal examination, PSA)
- ☐ Other (specify):

_____

97 Since March 20, 2020, have you had to avoid getting urgent care at a hospital emergency room or at an emergency clinic due to the COVID-19 pandemic?

- ○ No
- ○ Yes

Display This Question:

If Since March 20, 2020, have you had to avoid getting urgent care at a hospital emergency room or a... = Yes

98 What medical emergency or symptoms were you experiencing (specify)?

_____

99 Are you on chemotherapy, immunotherapy or radiation therapy for cancer?

- ☐ No
- ☐ Yes, chemotherapy
- ☐ Yes, immunotherapy
- ☐ Yes, radiation therapy

Display This Question:

If Are you on chemotherapy, immunotherapy or radiation therapy for cancer? = Yes, chemotherapy

Or Are you on chemotherapy, immunotherapy or radiation therapy for cancer? = Yes, immunotherapy

Or Are you on chemotherapy, immunotherapy or radiation therapy for cancer? = Yes, radiation therapy

100 Since March 20, 2020, have you had to postpone any cancer therapy session(s) due to the COVID-19 pandemic?

- ○ No
- ○ Yes

Display This Question:

If Since March 20, 2020, have you had to postpone any cancer therapy session(s) due to the COVID-19... = Yes

101 If yes, how many sessions were canceled (specify)?

_____

102 Would you be willing to have a blood test to detect antibodies to the COVID-19 virus?

- ○ No
- ○ Yes

Display This Question:

If Would you be willing to have a blood test to detect antibodies to the COVID-19 virus? = Yes

103 Select all that apply (We will contact you at a later date once we obtained funding for these tests):

- ☐ At home with a self-collection kit (finger prick)
- ☐ At a clinic ordered by a physician

104 Please provide any additional comments regarding your experience during the coronavirus COVID-19 pandemic

_____

_____

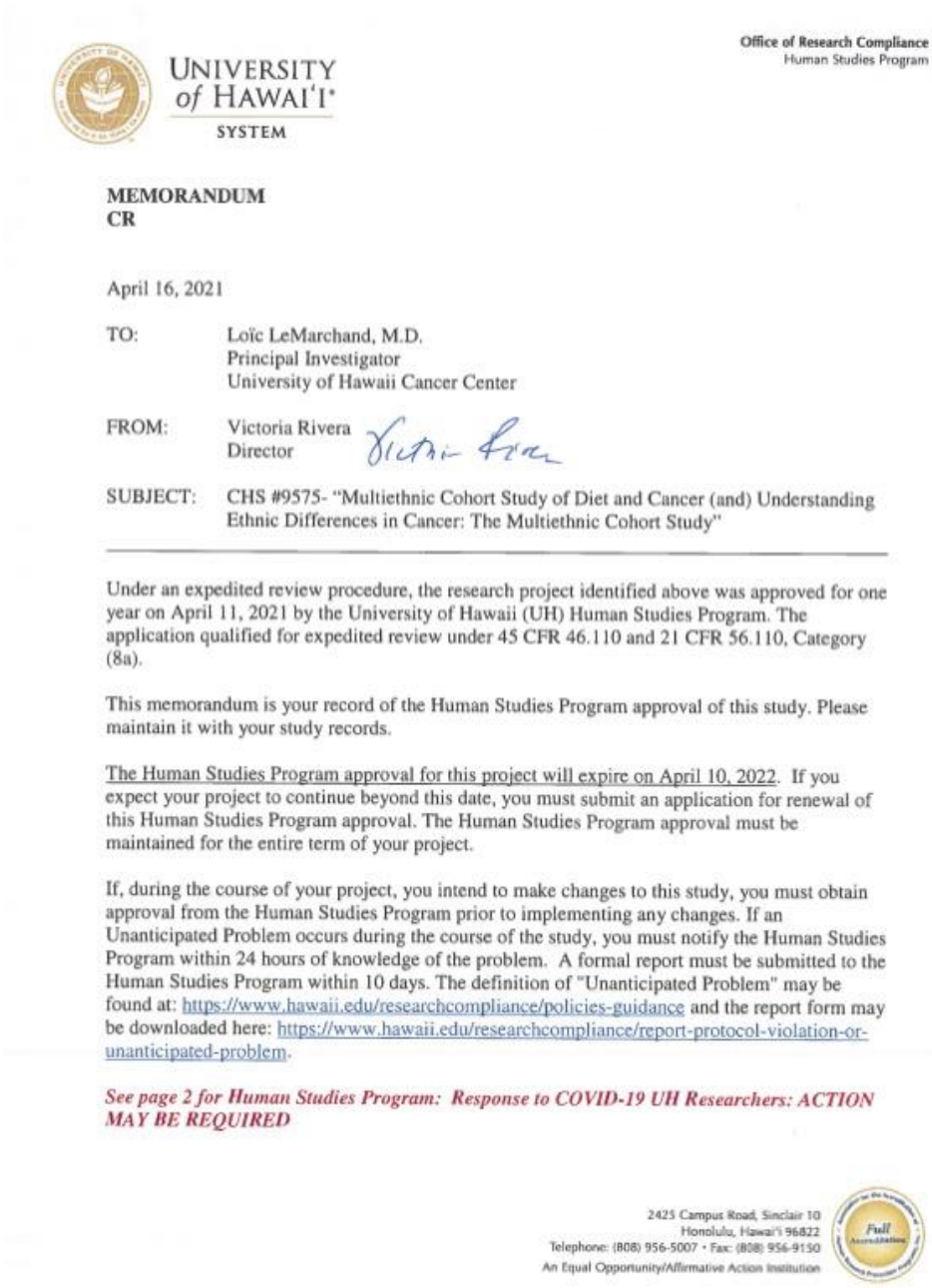
_____

_____

_____

End of Block: Block 5

APPENDIX C. University of Hawai‘i Institutional Review Board Approval Letter



UNIVERSITY of HAWAI'I SYSTEM

Office of Research Compliance
Human Studies Program

MEMORANDUM
CR

April 16, 2021

TO: Loïc LeMarchand, M.D.
Principal Investigator
University of Hawaii Cancer Center

FROM: Victoria Rivera
Director

SUBJECT: CHS #9575- "Multiethnic Cohort Study of Diet and Cancer (and) Understanding Ethnic Differences in Cancer: The Multiethnic Cohort Study"

Under an expedited review procedure, the research project identified above was approved for one year on April 11, 2021 by the University of Hawaii (UH) Human Studies Program. The application qualified for expedited review under 45 CFR 46.110 and 21 CFR 56.110, Category (8a).

This memorandum is your record of the Human Studies Program approval of this study. Please maintain it with your study records.

The Human Studies Program approval for this project will expire on April 10, 2022. If you expect your project to continue beyond this date, you must submit an application for renewal of this Human Studies Program approval. The Human Studies Program approval must be maintained for the entire term of your project.

If, during the course of your project, you intend to make changes to this study, you must obtain approval from the Human Studies Program prior to implementing any changes. If an Unanticipated Problem occurs during the course of the study, you must notify the Human Studies Program within 24 hours of knowledge of the problem. A formal report must be submitted to the Human Studies Program within 10 days. The definition of "Unanticipated Problem" may be found at: https://www.hawaii.edu/researchcompliance/policies-guidance and the report form may be downloaded here: https://www.hawaii.edu/researchcompliance/report-protocol-violation-or-unanticipated-problem.

See page 2 for Human Studies Program: Response to COVID-19 UH Researchers: ACTION MAY BE REQUIRED

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