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Control of Atherosclerotic Risk Factors During the
COVID-19 Pandemic in the U.S.Ming-Sum Lee, MD, PhD,¹ Aiyu Chen, MPH,² Hui Zhou, PhD,² John Herald, MD,¹
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INTRODUCTION

Public health response to the coronavirus disease 2019 (COVID-19) pandemic led to widespread social and economic changes and disruption of healthcare delivery. During the pandemic, there was a reduction in primary care visits with a higher proportion of telemedicine encounters.¹ Telemedicine visits were associated with lower new medication prescriptions and less frequent assessments of blood pressure (BP) and cholesterol levels.^{2,3}

Lockdown restrictions coincided with an observed reduction in physical activity, weight gain, and increased rates of depression and anxiety.^{4–9} Pandemic-related changes in cardiovascular risk factors and the 10-year predicted risk of atherosclerotic cardiovascular disease (ASCVD) were evaluated in adults within an integrated healthcare system in the U.S.

METHODS

The study included Kaiser Permanente Southern California (KPSC) members aged 40–79 years with lipid panel and BP measurements before the pandemic (March 19, 2019–March 18, 2020) and another set of measurements after COVID-19 vaccines became available, >9 months into the pandemic (December 14, 2020–December 13, 2021). KPSC is an integrated healthcare delivery system that provides comprehensive care, including outpatient, inpatient, and pharmaceutical benefits. Patients who were not KPSC members and those with established ASCVD (i.e., coronary artery disease, cerebral vascular disease, or peripheral vascular disease) were excluded. An individual's estimated 10-year ASCVD risk during each study period was calculated using the pooled cohort equation per guideline recommendations.¹⁰ The patient's age on March 19, 2020 was used for ASCVD risk estimation for both periods so that differences in ASCVD risk estimation reflect differences in risk factor control. The distribution of cardiovascular risk factors and ASCVD scores was assessed in the population before and during the pandemic.

Multivariable logistic regression modeling was performed to evaluate the association between baseline characteristics and a >10% increase in estimated ASCVD risk during the pandemic. Variables in the model included age, sex, race/ethnicity, income, hypertension, diabetes, smoking status, and BMI. ORs and 95%

CI were calculated. Analyses were performed with Stata 14 (StataCorp, College Station, TX). A 2-sided $p < 0.05$ was used to define statistical significance. This study was approved by the IRB of KPSC, with a waiver of informed consent.

RESULTS

Of 349,185 KPSC members with lipid and BP information before the pandemic and during the pandemic, the median age was 59 years (IQR=51–66), 58.4% were women, 34.5% were White, 8.7% were Black, 16.7% were Asian, and 36.6% were Hispanic. During the pandemic, a higher proportion of individuals had uncontrolled hypertension ≥ 140 mmHg (17.1% vs 13.1%) and elevated cholesterol ≥ 240 mg/dL (10.8% vs 9.9%) (Table 1). At a population level, the median estimated 10-year ASCVD risk increased from 6.0% (IQR=2.3%–13.1%) before the pandemic to 6.3% (IQR=2.5%–13.5%) during the pandemic, and a higher proportion of individuals were categorized as having high ($\geq 20\%$) ASCVD risk (13.9% vs 13.0%). Subgroup analysis of patients treated with statins or hypertension medications showed similar findings. Among patients on hypertension medications, 23.6% had uncontrolled hypertension ≥ 140 mmHg during the pandemic compared with 20.1% before the pandemic. Among those on statin and hypertension medications, the difference was 22.9% during the pandemic and 17.8% before the pandemic.

During the pandemic, 6,792 (1.9%) individuals had a >10% increase in their estimated ASCVD risk. Factors associated with increased odds of having >10% increase in ASCVD risk included older age (OR=3.5; 95% CI=3.4, 3.6; for each decade increase), male sex (OR=1.8; 95% CI=1.7,

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Table 1. Cardiovascular Risk Factors and Estimated 10-Year ASCVD Risk Before and During the COVID-19 Pandemic (N=349,185)

ASCVD risk and risk factors	Prepandemic (March 2019–March 2020)	Pandemic (December 2020–December 2021)	p-value ^a
ASCVD 10-year predicted risk ^b			
Median (IQR), %	6.0 (2.3–13.1)	6.3 (2.5–13.5)	<0.001
<5%	154,547 (44.3)	150,753 (43.2)	<0.001
5% to <7.5%	44,134 (12.6)	43,945 (12.6)	
≥7.5% to <20%	105,274 (30.1)	106,065 (30.4)	
≥20%	45,230 (13.0)	48,422 (13.9)	
SBP, mmHg			
Median (IQR)	127 (117–135)	129 (119–137)	<0.001
<120	106,859 (30.6)	91,667 (26.3)	<0.001
120 to <130	94,034 (26.9)	90,654 (26.0)	
130 to <140	102,746 (29.4)	107,352 (30.7)	
140 to <160	37,309 (10.7)	47,782 (13.6)	
≥160	8,237 (2.4)	12,030 (3.5)	
DBP, mmHg			
Median (IQR)	74 (67–80)	74 (67–81)	<0.001
<80	253,789 (72.7)	246,334 (70.6)	<0.001
80 to <90	76,344 (21.9)	80,638 (23.1)	
90 to <100	15,320 (4.4)	17,711 (5.1)	
≥100	3,732 (1.1)	4,502 (1.3)	
Cholesterol, mg/dL			
Median (IQR)	184 (157–213)	184 (155–214)	<0.001
<200	223,814 (64.1)	221,817 (63.5)	<0.001
200–239	90,635 (26.0)	89,515 (25.6)	
≥240	34,736 (9.9)	37,853 (10.8)	
HDL, mg/dL			
Median (IQR)	50 (42–61)	51 (43–61)	<0.001
<40	60,324 (17.3)	58,266 (16.7)	<0.001
40 to <60	192,724 (55.2)	190,680 (54.6)	
≥60	96,137 (27.5)	100,239 (28.7)	
LDL, mg/dL			
Median (IQR)	108 (84–133)	106 (80–132)	<0.001
<70	47,177 (13.5)	56,038 (16.1)	<0.001
70 to <100	95,810 (27.4)	96,045 (27.5)	
100 to <130	108,817 (31.2)	101,810 (29.2)	
130 to <160	67,505 (19.3)	65,138 (18.7)	
160 to <190	23,064 (6.6)	23,342 (6.7)	
≥190	6,812 (2.0)	6,811 (2.0)	
Triglyceride, mg/dL			
Median (IQR)	118 (84–169)	121 (86–173)	<0.001
<150	224,540 (67.1)	218,508 (65.5)	<0.001
150 to <200	54,888 (16.4)	56,264 (16.9)	
200 to <500	53,290 (15.9)	56,680 (17.0)	
≥500	1,953 (0.6)	1,935 (0.6)	
Smoking status ^c			
Never	253,132 (72.5)	251,786 (72.1)	<0.001
Quit	79,165 (22.7)	82,056 (23.5)	<0.001
Passive	1,291 (0.4)	1,264 (0.4)	
Active	15,481 (4.4)	13,963 (4.0)	
Missing	116 (0.03)	116 (0.06)	

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Table 1. Cardiovascular Risk Factors and Estimated 10-Year ASCVD Risk Before and During the COVID-19 Pandemic (N=349,185) (continued)

ASCVD risk and risk factors	Prepandemic (March 2019–March 2020)	Pandemic (December 2020–December 2021)	p-value ^a
Hypertension treatment			
Yes	151,373 (43.4)	162,667 (46.6)	<0.001
No	197,812 (56.6)	186,518 (53.4)	
Statin			
Yes	131,592 (37.7)	147,222 (42.2)	<0.001
No	217,593 (62.3)	201,963 (57.8)	
HgbA1c level, %			
	n=327,611	n=334,272	
Median (IQR)	5.7 (5.5–6.1)	5.7 (5.5–6.2)	<0.001
<5.7	170,925 (52.2)	169,078 (50.6)	<0.001
5.7 to <6.5	97,337 (29.7)	99,897 (29.9)	
6.5 to <8.5	44,042 (13.4)	47,825 (14.3)	
≥8.5	15,307 (4.7)	17,472 (5.2)	
BMI, kg/m ²			
	n=346,353	n=338,100	
Median (IQR)	28.6 (25.2–32.9)	28.6 (25.1–32.9)	<0.001
<18.5	2,151 (0.6)	2,526 (0.8)	<0.001
18.5 to 24.9	80,317 (23.2)	78,775 (23.3)	
25.0 to 29.9	124,355 (35.9)	120,380 (35.6)	
30.0 to 39.9	116,481 (33.6)	113,384 (33.5)	
≥40.0	23,049 (6.7)	23,035 (6.8)	

Note: Boldface indicates statistical significance ($p < 0.05$).

^aWilcoxon matched-pairs signed-rank test or Student's *t*-test for continuous variables and Pearson chi-square for categorical variables.

^bEstimated 10-year ASCVD risk during each study period was calculated using the pooled cohort equation as per American Heart Association and American College of Cardiology guideline recommendations. The patient's age on March 19, 2020 was used for calculation for both the prepandemic period and the pandemic period.

^cSelf-reported smoking status from the electronic health record.

ASCVD, atherosclerotic cardiovascular disease; DBP, diastolic blood pressure; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SBP, systolic blood pressure.

1.9), Black race (OR=2.2; 95% CI=2.0, 2.4), and low income <\$45,000 per year (OR=1.3; 95% CI=1.2, 1.4).

DISCUSSION

In this racially and ethnically diverse population in southern California, the COVID-19 pandemic was associated with a higher proportion of individuals with uncontrolled BP and cholesterol than in the prepandemic period, despite increased treatment attempts. Suboptimal risk factor control resulted in a statistically significant increase in their estimated 10-year ASCVD risk. Individuals who were older, Black, or with low income were disproportionately affected. Targeted efforts to improve cardiovascular risk factor management, such as through programs to improve hypertension control in vulnerable populations, will be important to ensure improved cardiovascular health outcomes in the coming years.

Limitations

Limitations of this study include the observational design and inclusion of only those with lipids and BP

measurements. Findings from this well-insured population may not be generalizable to those without insurance.

CONCLUSIONS

During the COVID-19 pandemic, widespread disruptions of healthcare delivery were associated with an increased proportion of individuals with suboptimally controlled cardiovascular risk factors. As hospitals and clinics resume normal services, special attention should be paid to the evaluation and treatment of cardiovascular risk factors.

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