RESEARCH LETTER

Effects of COVID-19 pandemic on physical activity in children and young adults with implanted devices

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Children and young adults with preexisting cardiovascular disease (CVD) may be disproportionately affected by the collateral health consequences of the coronavirus disease 2019 (COVID-19) pandemic. In addition to a higher risk of morbidity and mortality from COVID-19,[1] young persons with CVD may be more susceptible to alterations in physical activity (PA) and poor health outcomes[2] owing to the unprecedented loss of structured school days, reduced sports participation, increased screen time, and social isolation.[3] However, data on the acute and long-term effects of the pandemic on PA in young persons with established CVD risk remain scarce.

We leveraged data from electronic health records and implanted cardiac devices, which automatically collect continuous PA data, to analyze objective changes in daily PA during distinct phases of the COVID-19 pandemic relative to the same periods 1 year earlier. The study cohort included 261 patients 35 years and younger enrolled in the remote cardiac device monitoring program at the University of North Carolina and 9 affiliated hospitals who received an implanted cardiac monitor, pacemaker, or implantable cardioverter-defibrillator before February 15, 2019, and had continuous PA monitoring from March 15, 2019, to December 31, 2020. From the initial cohort, 174 patients were excluded, primarily because of incomplete device data (n = 167) or a diagnosis of COVID during study follow-up (n = 5). Linear mixed effects models with daily PA values as the unit of analysis and a random intercept for each patient were used to estimate trajectories of PA during the stay-at-home order in North Carolina (March 15 through May 8, 2020) and reopening phase of the pandemic (May 9 to December 31, 2020) relative to the corresponding periods in 2019. This study was approved by the Institutional Review Board of the University of North Carolina. Statistical analyses were performed using R version 4.0.5 (R Core Team, 2020, Vienna, Austria).

Overall, 87 patients met study inclusion criteria (19 [21.8%] had implanted cardiac monitors, 27 [31.0%] had pacemakers, and 41 [47.12%] had implantable cardioverter-defibrillators). A rapid and significant decrease in PA during the stay-at-home period was observed compared with the corresponding period in 2019 (−25.6 min/d; 95% confidence interval [CI] −22.5 to −28.7 min/d; $P < .001$]. PA remained lower after the stay-at-home order was lifted (−11.4 min/d; 95% CI −9.8 to −13.0 min/d; $P < .001$) and after adjustment for age, sex, and race (Figure 1). Nonwhite race and female sex were associated with lower levels of PA during the reopening period (−69.8 minutes; 95% CI −14.7 to −125.4 minutes; $P = .018$).

This study demonstrates that children and young adults with implanted cardiac devices experienced a significant decline in PA during a government-mandated COVID-19 stay-at-home order compared with the same period in 2019. While PA initially increased after the stay-at-home order was lifted, it subsequently decreased as schools reopened for online and later in-person learning in fall 2020. This pattern of prolonged inactivity is concerning given the well-known cardiovascular and psychosocial health benefits of PA in children and young adults.[4] Electrophysiologists are well positioned to use readily available PA data from implanted cardiac devices to counsel young persons on the importance of staying active and preventing clinical deterioration during COVID-19. Findings from this investigation of objective,

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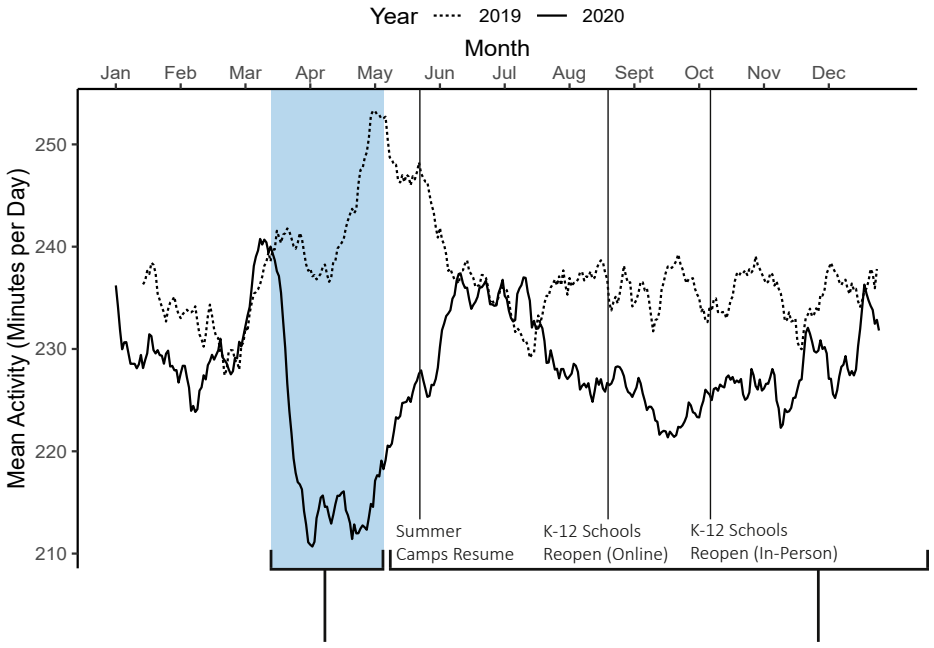

Change in Activity During Mandatory COVID Stay-At-Home Order: March 15 - May 8

	Change in Activity (minutes)	95% CI	p-value
Hazard Period	-25.58	-28.65 to -22.51	<0.001
Non-white race	-53.65	-111.43 to 4.12	0.08
Age (per year)	-1.45	-4.86 to 1.95	0.41
Female	-63.84	-123.31 to -4.37	0.04
Obese	-9.05	-68.51 to 50.41	0.77

Change in Activity During Reopening Phase: May 9 - December 31

	Change in Activity (minutes)	95% CI	p-value
Hazard Period	-11.36	-12.97 to -9.75	<0.001
Non-white race	-69.79	-125.42 to -14.70	0.02
Age (per year)	-1.86	-5.14 to 1.42	0.28
Female	-59.02	-116.27 to -1.77	0.05
Obese	-6.81	-64.05 to 50.44	0.82

Figure 1 Comparison of mean activity from 2019 to 2020. Mean physical activity (PA) in minutes per day stratified by year. Linear mixed effects models demonstrate that PA declined significantly during the mandatory stay-at-home order (*blue rectangle*) after adjustment for race, age, sex, and obesity. PA trends associated with the dates of specific government regulated reopenings are also illustrated (*vertical lines*). Summer camps resumed on May 22, 2020; kindergarten through 12th grade schools opened virtually on August 17 and then in-person at full capacity on October 5, 2020. CI = confidence interval; COVID = coronavirus disease.

device-based activity data complement larger survey-based studies of PA in children,[5] emphasizing the need to determine the long-term consequences of public health policies in children and young adults, especially in minority populations, and the importance of developing targeted activity interventions to mitigate potential downstream health consequences.

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