Cardiorespiratory fitness and depression symptoms among adults during the COVID-19 Pandemic: Cooper Center Longitudinal Study

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ABSTRACT

This study examined the relation between cardiorespiratory fitness (fitness) and depression symptoms prior to and during COVID-19 among adults seeking preventive medical care. Participants consisted of 967 patients attending the Cooper Clinic (Dallas, TX) pre-pandemic (March 2018-December 2019) and during the pandemic (March-December 2020). The outcome, depression symptoms, was based on the Center for Epidemiological Studies-Depression (CES-D). Maximal metabolic equivalents task (MET) levels for fitness were determined from the final treadmill speed and grade. Multiple linear regression models were computed by sex. Analysis revealed that mean fitness decreased from 11.4 METs (SD = 2.1) prior to the pandemic to 10.9 METs (SD = 2.3) during the pandemic (p-value = 0.001). The mean CES-D score increased from 2.8 (SD = 3.1) before to pandemic to 3.1 (SD = 3.2) during the pandemic (p-value = 0.003). Results from multiple linear regression indicate that increased fitness was associated with a statistically significant decrease in depression scores in men (−0.17 per MET; 95% CI −0.33, −0.02) but not women. This modest decrease may have been tempered by high fitness levels and low depression scores at baseline in this well-educated sample.

INTRODUCTION

1. Introduction

The SARS-CoV-2 (COVID-19) outbreak was first reported in China on December 31, 2019, and the first case in the United States (US) was observed in Washington State on January 19, 2020 (Holshue et al., 2020). With its spread, this pandemic has caused more morbidity and mortality than other human coronaviruses in the recent past (de Bruin and Bennett, 2020; Park et al., 2020). Countries have taken various measures to minimize transmission such as quarantine, social distancing, closures or remote learning in schools, lockdowns, shelter in place, and closure of borders (Anderson et al., 2020; Courtemanche et al., 2020; Dagan et al., 2021; Shuval et al., 2022). The introduction of highly effective COVID-19 vaccines (Self et al., 2021) enabled the reopening of many establishments (e.g., schools and workplaces); however, vaccination uptake varies considerably across US states and the world (Centers for Disease Control and Prevention, 2022a), as do COVID-19 related policy measures (Hale et al., 2021).

While these measures were paramount in curtailing infection, they have disrupted daily life and often led to social isolation that negatively affects physical and mental health (Giuntella et al., 2021; Holingue et al., 2020b). For example, a study by Holingue et al. (2020b), among a nationally representative sample of Americans adults without prior mental health conditions, found that 15% of adults experienced minor psychological distress and 13% experienced significant distress during the initial stages of pandemic. Moreover, Giuntella observed that physical inactivity was a significant risk factor for symptoms of depression among college students (Giuntella et al., 2021). Specifically, they found that the COVID-19 pandemic led to reduced physical activity (less daily steps), increased sleep time, less time socializing, and higher symptoms of depression. A systematic review by Wolf et al. (2021), summarizing studies primarily among adults, similarly observed that moderate to vigorous intensity physical activity was related to 12–32%
lower odds of depressive symptoms during the pandemic. The evidence indicates that physical activity has protective effects against the onset of depression with a number of suggested underlying antidepressant physiological and psychological mechanisms, such as changes in neuropsychological, oxidative stress, and enhanced self-efficacy (Kandola et al., 2019; Xie et al., 2021).

Studies examining the relationship between physical activity and depression during the COVID-19 pandemic predominately rely on self-report which is subject to recall bias (Brenner and DeLamater, 2014; Wolf et al., 2021). Hence, in the current study we examine effects of objectively measured cardiorespiratory fitness (henceforth ‘fitness’) on depression during the pandemic. Fitness is regarded as more representative of habitual physical activity than subjective activity measurement (DeFina et al., 2015; Swift et al., 2013). Prior longitudinal research linked decreased fitness to increased depression risk (Dishman et al., 2012). This relationship, however, was not examined during the COVID-19 pandemic. A study by Dun et al. found that fitness was inversely related to depression during the pandemic, however, the study was cross-sectional and focused on young adults (Dun et al., 2021). In the present research, using a more robust longitudinal approach, we explore whether changes in fitness were related changes in symptoms of depression during the pandemic. In doing so, we focus on adult patients presenting at a preventive medicine clinic before and during the pandemic.

2. Methods

We examined changes in fitness and depression symptoms prior and during the COVID-19 pandemic among patients at Cooper Clinic (Dallas, TX) who enrolled in the Cooper Center Longitudinal Study (CCLS) and provided informed consent. The CCLS is an ongoing prospective study aimed at examining the effects of lifestyle behavior on health and longevity (Shuval et al., 2012). CCLS participants are community dwelling adult men and women who come to the Cooper Clinic for preventive medicine visits (either referred by their employer or self-referred). They are predominantly non-Hispanic white and well educated (Farrell et al., 2020). In the current study, participants were considered for inclusion if they came to the clinic for preventive medicine visits twice: pre-pandemic (March 2018-December 2019) and during the pandemic (March-December 2020). We expanded the baseline (pre-pandemic) period to have a greater chance of retroactively finding a baseline visit for participants who came to the clinic for a preventive medical exam during the pandemic. The pandemic period began with its onset (March 2020) through the end of December (2020); this coincided with the rise of cases during the second wave in the United States and prior to vaccines becoming more widespread and the easing of social distancing measures in 2021 (Barbieri et al., 2021; Centers for Disease Control and Prevention, 2022b). Additional inclusion criteria consisted of age (20–70 years), not pregnant, and having complete information on the primary variables (fitness and depression score) and pertinent individual covariates (age, sex, race/ethnicity, current smoking, alcohol intake, BMI), as well as US state and county of residence for local COVID-19 case rates and mask requirements. These inclusion criteria resulted in 988 participants. Of these, 9 participants were excluded due to a personal history of myocardial infarction, stroke, or diabetes, 8 due to unexplained weight loss, and 4 due to underweight status (BMI < 18.5 kg/m²) since this could be indicative of an underlying medical condition (Knell et al., 2018). This led to a final analytic sample of 967 apparently healthy participants. The CCLS is approved on an annual basis by its Institutional Review Board.

Cardiorespiratory fitness. Fitness was assessed during the clinic visits and determined via a maximal treadmill test using the modified Balke protocol, as previously described (Balke and Ware, 1959; LaMonte et al., 2005; Shuval et al., 2021). Based on the final treadmill speed and grade, maximal metabolic equivalents task (MET) levels for fitness were estimated where 1 MET = 3.5 mL O₂ · kg⁻¹ · min⁻¹ (LaMonte et al., 2005).

Research has found that the duration of the treadmill test is highly correlated with maximal oxygen update in both men (r = 0.92) and women (r = 0.94) (Leonard et al., 2021; Pollock et al., 1982, 1976). Maximal METs levels were estimated both pre-pandemic and during the pandemic. The protocol for measuring fitness was the same at both visits with the exception of required mask-wearing during the pandemic.

Depression symptoms. The assessment of depression symptoms was based on responses to the Center for Epidemiological Studies-Depression (CES-D-10) survey. This is a 10-item scale which measures depressive symptoms in the past week (Andresen et al., 1994; Hoang et al., 2011). The instrument is widely used for the screening of depressive symptoms with good psychometric properties (Andresen et al., 1994; Molebbi et al., 2018). The survey items consist of depressed affect (3 items), positive affect (2 items), and somatic symptoms (5 items) with a Likert type scale with a score of 0 given to responses of “rarely or none of the time” and a score of 3 for responses of “all of the time” (Baron et al., 2017). Responses yield a total depression severity score ranging from 0 to 30, with a higher score indicating more depressive symptoms (Hoang et al., 2011). Previous research has found a cutoff of ≥10 to indicate clinically relevant symptoms of depression (Hoang et al., 2011; Lee and Chokkanathan, 2008; Lue et al., 2010).

Covariates. Participants’ characteristics included age, sex, race/ethnicity (non-Hispanic black, non-Hispanic white, Hispanic, other), employment (full time: yes/no), and retirement (yes/no). Participants’ alcohol consumption, smoking behavior, and history of depression were assessed via survey at the clinic visit. More specifically, the number of alcohol drinks per week of beer (12 oz.), wine (5 oz.), and hard liquor (1.5 oz.) consumed was regarded as a continuous variable, whereas current smoking (yes/no), and history of depression (yes/no) were dichotomous variables. History of depression was based on participants reporting having a significant problem with depression on the medical history questionnaire. BMI (kg/m²) was computed using the standard formula based on measured weight and height during a clinic visit. COVID-19 antibody testing began at the Cooper Clinic on May 15th 2020. In addition, the COVID-19 case rate specific to participant’s county of residence on the date of their clinic visit was derived from the COVID-19 data repository at Johns Hopkins University Center for Systems Science and Engineering (Dong et al., 2020). Specifically, the COVID-19 case rate was computed by dividing the cumulative number of cases in the county on the date of the clinic visit by the population size and then multiplying by 100. Moreover, COVID related policy (i.e., public mask mandates: yes/no) were obtained from the Centers for Disease Control and Prevention (CDC) (Centers for Disease Control and Prevention, 2021), and linked by participants’ county of residence and date of clinic visit.

Statistical Analysis. Characteristics of participants before and during the pandemic were summarized by sex and compared using paired t-tests for continuous characteristics and tests of marginal homogeneity for categorical characteristics. Within-person changes in CES-D score were related to within-person changes in fitness and health behaviors using mixed effects multiple linear regression to control for between-person differences as well as the local COVID-19 case rate and mask requirements. Specifically, the fixed effects included time (prior/during to the pandemic), fitness (between and within), current smoking (between and within for men only), alcohol intake (between and within), COVID-19 case rate and mask orders. A random subject effect was included to accommodate correlation between both visits of the same participant. Models were fit separately to men and women. Due to low variability of race/ethnicity (89.2% non-Hispanic white) models adjusted for non-Hispanic white vs other race/ethnicity. Models additionally adjusted for age (between subjects). BMI was not included in the models since it is on the causal pathway of fitness and depression (Gárdenas Fuentes et al., 2018; Luppino et al., 2010). Models for women did not include current smoking because only one woman reported smoking pre-pandemic. In addition, employment and retirement status, depression history, as well as COVID-19 antibody testing had missing
3. Results

Participants’ mean age was 52.2 years (SD = 8.2) at baseline (i.e., prior to the pandemic) and more than three fourths (78.1%) were men. Most (92.8%) were college educated, and 89.2% were non-Hispanic white, 1.8% were non-Hispanic black, 5.1% Hispanic, and 3.9% were of other race/ethnicities. Moreover, 80.7% were employed, and 5.5% were retired at baseline. Table 1 presents participants’ characteristics prior to and during COVID-19. Briefly, prior to the pandemic, the mean fitness was 11.4 METs (SD = 2.1), whereas during the pandemic mean fitness decreased to 10.9 METs (SD = 2.3) (p-value < 0.001). The mean CES-D score increased from 2.8 (SD = 3.1) prior to the pandemic to 3.1 (SD = 3.2) during the pandemic (p-value = 0.003). At the time of their clinic visit, 74.6% of participants resided in counties with public mask mandates in place with an average COVID-19 infection rate of 2.3% (SD = 1.7). Participant’s characteristics before and during the pandemic stratified by sex appear in Table 1.

Fig. 1 presents mean depression (CES-D) scores before and during the pandemic among men and women adjusting for covariates. In men, the

| Table 1 | Participants’ characteristics prior<sup>a</sup> and during<sup>b</sup> the COVID-19 pandemic stratified by sex: Cooper Center Longitudinal Study. |
|---------|---------------------------------------------------------------------------------------------------------------------------------|
|         |                                                                                                                                |
| N       |                                                                                                                                |
| Age (years) Mean (SD) |                                                                                                                                |
| Before Pandemic<sup>c</sup> | During Pandemic<sup>b</sup> |
| 755     | 755                                                                                                                            |
| 52.5 (8.2) | 53.7 (8.2) |
| Race/Ethnicity | Non-Hispanic White | Black | Hispanic | Other |
| n (%) | 683 (90.5%) | 10 (1.3%) | 33 (4.4%) | 29 (3.8%) |
| Non-Hispanic | n (%) | 16 (7.5%) | 17 (1.8%) | 49 (5.1%) | 38 (3.9%) |
| White | n (%) | 45 (6.0%) | 706 (93.5%) |
| N/A | 20 (9.4%) | N/A | 65 (6.7%) | N/A |
| College Education<sup>d</sup> | n (%) | 80 (10.6%) | 4 (0.5%) |
| Employed | n (%) | 38 (5.0%) | N/A |
| No | n (%) | 635 (84.1%) | 100 (10.3%) |
| Yes | n (%) | 40 (5.3%) | 13 (6.1%) |
| Retired | n (%) | 60 (10.6%) | N/A |
| No | n (%) | 635 (84.1%) | 20 (9.4%) |
| Yes | n (%) | 40 (5.3%) | 13 (6.1%) |
| Current Smoking | n (%) | 707 (93.6%) | 706 (93.5%) |
| No | n (%) | 635 (84.1%) | 697 (92.3%) |
| Yes | n (%) | 40 (5.3%) | 58 (7.7%) |
| Fitness (METs)<sup>e</sup> | Mean (SD) | 11.7 (2.0) | 11.3 (2.1) |
| Alcohol (drinks/wk) | Mean (SD) | 6.2 (5.9) | 6.3 (6.4) |
| BMI (kg/m<sup>2</sup>) | Mean (SD) | 27.4 (3.7) | 27.1 (3.8) |
| Depression History | No | n (%) | 717 (95.0%) | 717 (95.0%) |
| Yes | n (%) | 48 (6.4%) | 42 (5.6%) |
| No | n (%) | 707 (93.6%) | 713 (94.4%) |
| Yes | n (%) | 48 (6.4%) | 42 (5.6%) |
| Depression: CES-D<sup>f</sup> | Mean (SD) | 2.8 (3.1) | 2.9 (3.2) |
| Mask Mandate<sup>g</sup> | No | n (%) | 191 (25.3%) | 191 (25.3%) |
| Yes | n (%) | 564 (74.7%) | 157 (74.1%) |
| Case Rate (% of pop.)<sup>h</sup> | Mean (SD) | 2.35 (1.76) | 2.26 (1.66) |
| Covid-19 antibody test<sup>i</sup> | Negative | n (%) | 435 (57.6%) | 128 (60.4%) |
| Positive | n (%) | 16 (2.1%) | 2 (0.9%) |
| Unknown | n (%) | 304 (40.3%) | 82 (38.7%) |

Abbreviations: SD—standard error; BMI—body mass index; N/A—not applicable; CES-D—Center for Epidemiological Studies-Depression; Pop—population; wk—week; kg—kilogram; m—meter. a Prior to the pandemic: March 2018–December 2019. b During the pandemic: March–December 2020. c P-value—paired t-tests were used for differences in continuous variables, whereas paired tests of marginal homogeneity were used for categorical variables. d College education was defined as having a bachelor’s degree or higher at the second clinic visit (i.e., during the pandemic). e Fitness was assessed during the clinic visits and determined via a maximal treadmill test using the modified Balke protocol. Based on the final treadmill speed and grade maximal metabolic equivalents task (MET) levels for fitness were estimated where 1 MET = 3.5 mL O<sub>2</sub> · kg<sup>-1</sup> · min<sup>-1</sup>. f The COVID-19 case rate specific to participants’ county of residence on the date of their clinic visit was derived from the data repository at Johns Hopkins University Center for Systems Science and Engineering. Specifically, the COVID-19 case rate was computed by dividing the cumulative number of cases in the county on the date of the clinic visit by the population size and then multiplying by 100. g COVID-19 public mask mandates (yes/no) were obtained from the CDC and linked by participants’ county of residence and date of clinic visit; h COVID-19 antibody testing began at the Cooper Clinic on May 15, 2020.
adjusted mean CES-D score increased from 2.73 (95% CI 2.40, 3.06) to 2.75 (95% CI 2.41, 3.09) points prior to and during the pandemic, respectively. This increase was statistically insignificant during the pandemic (0.02 points; 95% CI −0.37, 0.41; p-value = 0.905); see Table 2. Among women, the adjusted mean CES-D score increased from 2.90 (95% CI 2.23, 3.58) to 3.50 points (95% CI 2.78, 4.21) prior to and during the pandemic, respectively (Fig. 1). This increase was not statistically significant (0.59 point; 95% CI −0.27, 1.46; p-value = 0.177); see Table 2. In sensitivity analysis, among a subgroup of participants with a narrower age range (40–60 years), CES-D score increased significantly in women only (1.05 point; 95% CI 0.05, 2.05; p-value = 0.039); see Table S1 (appendix).

In addition, Table 2 presents results from multiple linear regression of the depression scores (CES-D) on fitness and covariates adjusting for race/ethnicity and age (between subjects) among men and women. Between men, higher fitness levels were associated with lower depression scores, and, within men, increased fitness was associated with decreased depression scores. Specifically, a 1-MET higher fitness level was related to a 0.22 lower CES-D score (95% CI −0.32, −0.12; p-value < 0.001) between subjects; a 1-MET increase in fitness was related to a 0.17 decrease in CES-D score (95% CI −0.33, −0.02; p-value = 0.030) within subjects. None of the covariates (current smoking, alcohol intake, case rate, public mask order) were significantly related to depression scores in men (see Table 2). Among women, fitness and other covariates were not significantly related to depression scores.

Sensitivity analyses in participants with complete data for employment/retirement, or history of depression, or COVID-19 antibody testing showed similar findings pertaining to the relationship between fitness and depression scores (Tables S2-S4, appendix). Of note, is that participants with a prior history of depression had higher CES-D scores (on average) compared to their counterparts without a history of depression; see Table S3 (appendix). For example, men with a prior history of depression had an adjusted mean CES-D score 2.93 higher than those without depression history (95% CI 2.01, 3.85; p-value < 0.001). Changes in depression status within individuals (e.g., ‘no’ depression prior to the pandemic to ‘yes’ depression during the pandemic on the medical history) did not result in significant changes in CES-D scores.

4. Discussion

This study assessed changes in depression symptoms during the pandemic and explored whether these changes were related to changes in fitness among well-educated adults in a preventive medical setting. Findings show that adjusted depression scores increased somewhat during the pandemic but not significantly. Increases in fitness during the pandemic were significantly related to decreases in depression scores in men. While this relationship was statistically significant, the effect size was modest: each 1 MET increase in fitness was related to only a 0.17 decrease in the CES-D score. A CES-D score of 10 or higher indicates depression symptoms of depression, (Hoang et al., 2011) and men’s adjusted mean scores were markedly lower than this threshold both prior and during the pandemic (2.73 and 2.75, respectively). In women, the mean depression scores were similarly low before and during the pandemic (with the exception of women aged 40–60 years in subgroup analysis), and the fitness-depression symptoms relationship was not significant.

When comparing our findings to the literature, Giuntella observed a significant increase in CES-D scores (from 12.1 to 19.4) in college students during the pandemic (Giuntella et al., 2021). Both scores were above the clinically meaningful threshold of 10. They also found that less physical activity was associated with higher rates of depressive symptoms (Giuntella et al., 2021). In the present study, we similarly found that increases in fitness were related to decreases in depression scores (in men but not women), yet the relation is not robust. This likely stems from a combination of relatively high levels of fitness and low levels of depression as well as the age of study participants.

It is reasonable to assume that since participants in the present study are primarily middle-age or older from the CCLS, a higher socio-economic status cohort with access to preventive medical care (Abdul-lah et al., 2018), they experienced minimal disturbances to mental health, particularly compared to vulnerable populations (Giuntella et al., 2021). Previous research has found that older age and having more financial assets is protective against stressors and depression (Czeisler et al., 2021; Ettman et al., 2022, 2020). Nonetheless, in the current study, when examining a narrower age group (40–60 years), depression scores increased significantly during the pandemic among women, potentially indicating more susceptibility to pandemic related
measuring fitness was used at all clinic visits, during the pandemic CES-D scores. This finding is similar to that found in a multi-national depression status during the pandemic were not significantly related to without a history of depression; however, within person changes in (between subjects) had markedly higher depression scores than those effects among this subgroup. In addition, present findings indicate that participants (both women and men) with a prior history of depression (between subjects) had markedly higher depression scores than those without a history of depression; however, within person changes in depression status during the pandemic were not significantly related to CES-D scores. This finding is similar to that found in a multi-national study by Gémes which observed higher prevalence rates of depression during the pandemic among those with a prior mental health history, yet change over time was similar among those with or without a history (Gémes et al., 2022).

The current study has strengths and limitations that should be noted. Strengths include the longitudinal design and the use of objectively measured fitness. Fitness is a direct and physiological measure of habitual physical activity also influenced by non-modifiable factors, such as genetics (Leonard et al., 2021). While a consistent protocol for measuring fitness was used at all clinic visits, during the pandemic participants were required to wear masks, yet the mask type was not captured. A systematic review found that face masks minimally affect exercise performance and physiological measures (Shaw et al., 2021); however, other research shows that masks lead to increased discomfort and lower VO2max (Driver et al., 2022). Nonetheless, current results showing reduction in fitness levels during the pandemic are consistent with a previous study demonstrating worldwide declines in objectively measured step counts (Tison et al., 2020). An additional study limitation is that individual level information on COVID-19 related morbidity was not available on all participants. To address this shortcoming, we conducting sensitivity analysis on a subgroup of participants with data on COVID-19 antibody testing. Adjusting for this variable in multiple regression did not change the main findings materially. In addition, information was obtained at the aggregate level (Dong et al., 2020), which was matched to participants’ county of residence and date of visit. Additionally, policy level data (i.e., mask mandates) was gleaned from the CDC and accounted for in the analysis. Moreover, changes in fitness and depressive symptoms were evaluated from the same participants at two time points (prior and during the pandemic) using a robust longitudinal analytic approach. However, the sample might inherently include those less affected by the pandemic and willing to visit a preventive medicine clinic during this time. This could potentially reflect unique psychological traits (e.g., risk preferences) (Herberholz, 2020), yet these were not measured. Additionally, the CCLS cohort is homogenous regarding race/ethnicity and socio-economic status, which increases internal validity but limits generalizability. Furthermore, the sample size for women is markedly smaller than that for men (212 vs 755), which was addressed by stratification by sex. Studies have found depression to be more prevalent in women (Albert, 2015), which is part of the rationale for examining relationships by sex. The main relationship explored in this study should be explored in future research among a larger sample of women. Finally, some covariates had missing information and were included in sensitivity analyses only.

### Table 2

|                      | Men        |         |         |        | Women        |         |         |        |
|----------------------|------------|---------|---------|--------|--------------|---------|---------|--------|
|                      | Estimate   | 95% CI  | P-value |        | Estimate     | 95% CI  | P-value |
| Pandemic             | 0.02       | -0.37   | 0.905   | 0.59   | -0.27        | 0.177   | 1.46    |
| (prior)              |            |         |         |        |              |         |         |
| Fitness              | -0.22      | -0.32   | <0.001  | -0.10  | -0.31        | 0.334   | 0.11    |
| (between per MET)    |            |         |         |        |              |         |         |
| Fitness              | -0.17      | -0.33   | 0.030   | 0.13   | -0.23        | 0.489   | 0.49    |
| (within per MET)     |            |         |         |        |              |         |         |
| Current smoker       | 0.72       | -0.10   | 0.087   | N/A    | N/A          | N/A     | N/A     |
| (between)            | 1.53       |         |         |        |              |         |         |
| Current smoker       | -0.87      | -2.06   | 0.153   | N/A    | N/A          | N/A     | N/A     |
| (within)             | 0.32       |         |         |        |              |         |         |
| Alcohol              | -0.01      | -0.04   | 0.767   | 0.07   | -0.01        | 0.095   | 0.16    |
| (per drink/ wk)      | 0.03       |         |         |        |              |         |         |
| Alcohol              | -0.01      | -0.05   | 0.696   | 0.01   | -0.11        | 0.881   | 0.13    |
| (within)             | 0.03       |         |         |        |              |         |         |
| Case Rate            | 0.00       | -0.11   | 0.969   | 0.02   | -0.25        | 0.911   | 0.28    |
| (per % of pop)       | 0.12       |         |         |        |              |         |         |
| Public mask order    | 0.10       | -0.36   | 0.659   | 0.15   | -0.85        | 0.769   | 1.15    |
|                      | 0.56       |         |         |        |              |         |         |

Abbreviations: CES-D- Center for Epidemiology Studies Depression Scale; Pop- population; wk- week; CI- confidence interval.

* Models adjusted for race/ethnicity (Non-Hispanic white vs other race/ ethnicity) and age (between). ** n = 755 (men); n = 212 (women).

A Prior to the pandemic: March 2018- December 2019, and during the pandemic: March- December 2020; B Cardiorespiratory fitness was assessed during the clinic visits and determined via a maximal treadmill test using the modified Balke protocol. Based on the final treadmill speed and grade maximal metabolic equivalents task (MET) levels for fitness were estimated where 1 MET = 3.5 mL. O2 kg-1 min-1. C Models for women did not account for smoking since only one woman reported smoking pre-pandemic and none during. D The COVID-19 case rate specific to participants’ county of residence on the date of their clinic visit was derived from the data repository at Johns Hopkins University Center for Systems Science and Engineering. Specifically, the COVID-19 case rate was computed by dividing the cumulative number of cases in the county on the date of the clinic visit by the population size and then multiplying by 100. E COVID-19 related public mask mandates (yes/no) were obtained from the CDC and linked by participants’ county of residence and date of clinic visit.

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Institutional Review Board Statement

The study received approval from the University of Haifa Institutional Review Board (IRB). The CCLS is approved on an annual basis by its IRB.

Informed Consent Statement

Informed consent was obtained from all study participants.

Data Availability Statement

The Cooper Center Longitudinal Study (https://www.cooper...
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