



Essential and non-essential US workers' health behaviors during the COVID-19 pandemic

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ABSTRACT

We seek to quantify the relationship between health behaviors and work-related experiences during the COVID-19 pandemic by predicting health behaviors as a function of essential worker status, job loss, change in work hours, and COVID-19 experiences. We use multivariate models and survey data from 913 employed adults in a semi-rural mid-Atlantic US county, and test whether essential worker results vary by gender, parenthood, and/or university employment. Multivariate models indicate that essential workers used tobacco on more days (4.5; $p < .01$) and were less likely to sleep 8 h (odds ratio [OR] 0.6; $p < .01$) than non-essential workers. The risk of sleeping less than 8 h is concentrated among essential workers in the service industry (OR 0.5; $p < .05$) and non-parents (OR 0.5; $p < .05$). Feminine essential workers exercised on fewer days (-0.8; $p < .05$) than feminine non-essential workers. Workers with reduced work hours consumed more alcoholic drinks (0.3; $p < .05$), while workers with increased work hours consumed alcohol (0.3; $p < .05$) and exercised (0.6; $p < .05$) on more days. Essential worker status and changes in work hours are correlated with unhealthy behaviors during the COVID-19 pandemic.

1. Introduction

Health behaviors like physical activity and tobacco use are strong predictors of chronic disease and mortality (Lantz et al., 2010; Mokdad et al., 2004). Many health behaviors are established during adolescence (Sawyer et al., 2012) and remain stable in adulthood (Mahalik et al., 2013). Yet, stressful life events can increase negative health behaviors (Umberson et al., 2008) as people try to reduce tension and negative affect (Ensel and Lin, 1991; Folkman and Lazarus, 1980), and reduce positive health behaviors as these behaviors require an array of financial, time, and psychological resources (Pampel et al., 2010).

The COVID-19 global pandemic was a stressful life event (Horesh and Brown, 2020). As governments adopted various policies to slow virus spread, lives were disrupted. During the pandemic, adults' negative

health behaviors, like drinking alcohol (Ingram et al., 2020; Maffoni et al., 2021; Niedzwiedz et al., 2020; Valente et al., 2021; Zajacova et al., 2020) and smoking (Đogaš et al., 2020) increased across the globe, while adults' positive health behaviors, like eating a healthy diet (Ingram et al., 2020; Papandreou et al., 2020; Villadsen et al., 2021), engaging in physical activity (Đogaš et al., 2020; Knell et al., 2020; Maugeri et al., 2020; Meyer et al., 2020; Watson et al., 2021), and hours of sleep (Villadsen et al., 2021), declined. The rise in unhealthy patterns was generally greater for younger adults (Niedzwiedz et al., 2020; Zajacova et al., 2020; Blom et al., 2021), women (Niedzwiedz et al., 2020; Đogaš et al., 2020; Blom et al., 2021; Gutiérrez-Pérez et al., 2021), and those with higher socioeconomic status (Niedzwiedz et al., 2020; Valente et al., 2021; Blom et al., 2021). Yet, some studies found no behavioral change (Reynolds et al., 2021) or improvements in some

Abbreviations: FS, Family-focused survey; HCS, Health communication-focused survey; h, hours; PPE, personal protective equipment.

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health behaviors (Niedzwiedz et al., 2020; Hu et al., 2020). These inconsistencies between studies could reflect differential timing because behavioral change was greater in the spring and summer versus later in 2020 (Villadsen et al., 2021; Blom et al., 2021).

Another possibility for these inconsistent patterns is differences by employment experiences. In the US, workers were particularly affected by the pandemic and governmental responses: unemployment rose, work hours increased for some but decreased for others, and childcare responsibilities, especially for mothers, increased as schools and childcare centers shuttered (Casselmann and Koeze, 2021). For these reasons, we expect more unhealthy behaviors among workers who experience work disruptions (e.g., job loss or large changes in work hours), and more healthy behaviors among workers with greater job consistency and security.

Essential (vs. non-essential) workers faced additional stressors because their employment was deemed necessary for society's survival. First, their risk of contracting COVID-19 was greater than non-essential workers (Song et al., 2021). Second, essential workers in healthcare faced extraordinary pressure to meet the demands of the pandemic, often with inadequate personal protective equipment (PPE) and medical equipment, while in direct contact with ill patients (Cadge et al., 2021). Third, newly valorized service sector essential workers also faced work-based dangers without adequate PPE, but were generally paid less for working stigmatized (Mejia et al., 2021), lower socioeconomic status jobs (Hauser and Warren, 1997). Further, they often felt ambivalent about their new "hero" status given it did not result in better pay or protection (Hennekam et al., 2020). Fourth, relative to non-essential workers, essential workers score higher on the COVID Stress Scale (a 36-item measure with subscales for traumatic stress, fears of economic consequences, compulsive checking and reassurance seeking, danger and contamination fears, and xenophobia) (Bond et al., 2021), express greater suicidal ideation (Bond et al., 2021), and engage in greater substance use (McKay and Asmundson, 2020). Thus, we expect these stressors lead to a correlation between essential worker status and unhealthy behaviors. To the extent essential workers exhibit more unhealthy behaviors as a result of COVID-19-related challenges, healthcare screening and workforce policy may need to be modified in order to mitigate them, especially as new variants and waning immunity prolong these workplace challenges.

The objective of this study is to evaluate differences in US workers' health behaviors as a function of their employment- and pandemic-related experiences through September 2020, which was several months after lockdowns and social distancing measures were locally adopted.

2. Methods

2.1. Participants and survey procedure

The data are drawn from a larger study of a longitudinal cohort of adults living in one, semi-rural county with a large research university in a mid-Atlantic US state. Between May and September 2020, the University's government relations office coordinated messaging to local governments, school districts, and community organizations throughout the county. Public notification included brochures to local business organizations and assisted living communities, as well as public service announcements broadcast across both traditional and social media outlets. For this non-probability response sample, participants were selected if they indicated on a brief screener survey that they were aged 18 or older and had resided continuously in the county since March 2020. All participants provided written informed consent before completing the survey and were offered token compensation for participation (\$10 for survey completion alone; \$25 for survey completion and providing a biospecimen). All materials and procedures were approved by the Pennsylvania State University Institutional Review Board.

We utilize data from the brief initial survey collected during participant recruitment (results described elsewhere) (Lennon et al., 2022; Smith et al., 2021) and a full survey administered either online or by telephone between August and October 2020. Among all adults selected for study participation, there was greater attrition among parents of minor children between the initial and full surveys. To minimize survey fatigue during the full survey, the 604 adults living with minor children completed a family-focused survey (FS), while the 986 adults not living with a minor completed a health communication-focused survey (HCS). We analyzed results from employed adults in the FS and HCS surveys ($n = 1,297$) and excluded surveys with incomplete information on study variables. Item non-response was greatest for pandemic-related job loss ($n = 199$), sleep duration ($n = 117$), changes in work hours ($n = 101$), and frequency of drinking alcohol ($n = 93$). Relative to respondents with any missing data (all t-tests $p < .05$), those included in the final sample have greater alcohol frequency, perceived socioeconomic status, university employment, and identification as a non-Hispanic white person, but lower concerns about contracting COVID-19, fewer COVID-19 symptoms, and less pandemic job loss. The final sample included 913 employed adult respondents.

2.2. Questionnaire

We measured three self-reported health behaviors for all respondents: (1) Exercise frequency, as the number of days within the past 7 the respondent exercised for 30 or more minutes; (2) Alcohol consumption frequency, as the number of days within the past 30 the respondent drank an alcoholic beverage, and (3) Sleeping 8 or more hours a day, as a dichotomous indicator, though the question was asked somewhat differently in the FS and HCS samples. For workers in the HCS sample ($n = 553$), we also measure (4) Alcohol volume, as the usual number of drinks per drinking session, and (5) Tobacco use frequency, as the number of days within the past 30 the respondent had a cigarette or nicotine. See Supplemental Table 1 for the health behavior items in the FS and HCS surveys.

We classified participants as essential workers ($n = 323$) if they (1) self-identify as an essential worker, (2) report working face-to-face in healthcare, customer service, or as a first responder, and/or (3) for HCS sample members, if they are unable to perform all COVID-19 mitigation strategies because they are an essential worker. See Supplemental Table 2 for these survey items. Essential workers work in numerous industries (<https://www.cisa.gov/identifying-critical-infrastructure-during-covid-19>). Within our sample, we can differentiate essential workers in the Service ($n = 137$) and Healthcare ($n = 74$) industries.

We measure work experiences as follows: (1) Job loss, as a dichotomous indicator for respondents' reporting being laid off, furloughed or having lost a job due to the pandemic between March and July 31; (2) Work hours increased, as a dichotomous indicator if the calculated difference in the respondent's current work hours was at least 10 h greater than the hours reported for before March 2020; (3) Work hours decreased, as a dichotomous indicator if the calculated difference in the respondent's current work hours was at least 10 h fewer than the hours reported for before March 2020.

We measure COVID-19-related experiences as follows: (1) Life disrupted, with a 3-point scale to assess their degree of disruption from the pandemic (1 = not been disrupted, 3 = significantly disrupted). Those stating their lives were "somewhat," "slightly" or "mildly" disrupted in an open-ended question ($n = 6$) were coded equal to 1; (2) COVID-19 symptoms, with a 5-point scale to assess their experience of "dry cough, fever, shortness of breath" since January 2020 (1 = no symptoms, 5 = severe symptoms); and (3) State government too lenient, as a dichotomous indicator if the respondent thinking the "actions taken by your state government to prevent and/or reduce the spread of coronavirus (which causes the disease COVID-19)" is "too lenient." We evaluated essential workers' risk perceptions of the pandemic by exploring differences in (1) COVID-19 risk due to job, as a dichotomous indicator

for respondents' thinking they were personally at "increased risk for exposure to COVID-19 due to job position" and (2) Personal infection concern, with a 4-point scale to assess "how concerned are you personally about getting infected with coronavirus?" (1 = not very, 4 = very).

Control variables include (1) feminine gender, a dichotomous indicator that includes both transgender and cisgender women; (2) sexual/gender minority, a dichotomous indicator if respondents identify as lesbian, gay, bisexual or gender non-binary (3) racial/ethnic minority, as a dichotomous indicator based on detailed questions about race and ethnicity; and (4) socioeconomic status, as the 10-point MacArthur Scale of Subjective Social Status (Singh-Manoux et al., 2003). Using household roster data, we create the following mutually exclusive categories: (1) live with a romantic partner/spouse, but no minor child; (2) live with a minor, regardless of partnership status; and (3) do not live with a romantic partner or minor. We include a dichotomous indicator of co-residence with other family members (i.e., adult children, parents, or other relatives) from household roster data.

For supplemental models, we measure (1) Co-residence with own child, as a dichotomous indicator and regardless of the child's age to account for differences in caregiving demands; (2) Employment at the university, as a dichotomous indicator to account for their employer-based resources (i.e., greater job security, employee benefits, and remote work) that likely help these workers navigate the COVID-19 pandemic; and (3) for those in the HCS sample, Perceived stress to account for participant's lived stress experiences, as a scale adapted from Cohen et al. (1983) that averages 9 items ($\alpha = 0.90$) asking respondents to appraise life stressors in the past month on a 5-point scale (1 = never, 5 = frequently).

2.3. Analysis

We compare experiences by essential worker status and, among essential workers, by industry using two-sided T-tests of mean differences. We estimate multivariate regression models using Stata version 17, using ordinary least squares regression to predict exercise frequency, logistic regression for sleeping 8 or more hours, and negative binomial regression for days of alcohol consumption, alcohol volume, and days of tobacco use given these variables are overdispersed. Significance was set to 95% confidence.

3. Results

The combined average sample member is middle age (44 ± 12 years), feminine (68%), non-Hispanic white (91%), employed at the university (62%) with relatively high perceived socioeconomic status (7.1 ± 1.4), moderate exercise frequency (3.6 ± 2.3 days), moderate drinking frequency (9.5 ± 9.7 days), and low likelihood of sleeping 8 or more hours per day (34%) (See Table 1). Compared to FS respondents, HCS respondents (all $p < .05$) were older (45 vs. 43), more often a sexual/gender minority (9% vs. 5%), less likely to live with a romantic partner (72% vs. 90%), less likely to have reduced work hours (13% vs 18%) and perceived themselves to have a lower socioeconomic status (7.0 vs. 7.3). In the HCS sample, tobacco use was rare (0.69 ± 4.3) and drinking volume was low (1.29 ± 1.18) (See Table 1).

Relative to non-essential workers (all $p < .05$), essential workers have significantly elevated perceived risk of coronavirus exposure at their job (52% vs. 11%) and job loss (15% vs. 6%). In contrast, non-essential workers are more likely to sleep 8 h (37% vs 28%) and have greater university employment (71% vs 46%). In the HCS sample, essential workers used tobacco more frequently than non-essential workers (1.46 vs. 0.29) (See Table 2).

Essential workers significantly differ amongst themselves (all $p < .05$) (See Table 2). Those in the health care industry perceive the highest risk of contracting coronavirus at their job (70%) and least likely to have reduced work hours (8%), while those in the service industry had the

Table 1

Descriptive statistics for the full sample and by subsample survey.

Characteristic	Full Sample (N = 913)	FS Respondents (n = 360)	HCS Respondents (n = 553)
Health Behaviors			
Sleep 8 + hours — no. (%)	306 (34)	87 (24)	219 (39)
Days of exercise in last 7 days	3.62 ± 2.34	3.07 ± 2.35	3.97 ± 2.26
Days of alcohol drinking in last 30 days	9.45 ± 9.68	9.34 ± 9.45	9.48 ± 9.78
Number of drinks per session ^a	1.29 ± 1.18	—	1.29 ± 1.18
Days of tobacco use ^a	0.69 ± 4.30	—	0.69 ± 4.30
Perceived Stress^a			
	2.71 ± 0.70	—	2.71 ± 0.70
COVID-19 Experiences & Perceptions			
Risk of coronavirus exposure at own job — no. (%)	236 (26)	90 (25)	144 (26)
Concern about contracting coronavirus	3.17 ± 0.70	3.12 ± 0.71	3.20 ± 0.69
Life disrupted	2.25 ± 0.50	2.29 ± 0.52	2.24 ± 0.48
COVID-19 symptom severity	1.56 ± 0.89	1.56 ± 0.85	1.56 ± 0.92
State government too lenient — no. (%)	184 (20)	71 (20)	113 (20)
Employment Experiences			
Pandemic-based job loss — no. (%)	81 (9)	37 (10)	44 (8)
Work hours declined by 10 + h — no. (%)	136 (15)	65 (18)	71 (13)
Work hours increased by 10 + h — no. (%)	78 (9)	23 (6)	55 (10)
Work at university — no. (%)	568 (62)	201 (56)	367 (66)
Demographic and Social Characteristics			
Age	44.3 ± 12	43.0 ± 8	45.1 ± 14
Feminine gender — no. (%)	617 (68)	234 (66)	383 (69)
Sexual/gender minority — no. (%)	70 (8)	18 (5)	52 (9)
Racial/ethnic minority — no. (%)	83 (9)	28 (8)	55 (10)
Perceived socioeconomic status	7.09 ± 1.44	7.25 ± 1.36	6.97 ± 1.48
Partnership & parenthood status — no. (%)			
Co-residential partner, no minor children	401 (44)	0 (0)	401 (72)
No co-residential partner, no minor children	156 (17)	0 (0)	156 (28)
Minor children present	360 (39)	360 (100)	0 (0)
Live with other family — no. (%)	133 (15)	57 (16)	76 (14)

* Plus-minus values are means \pm SD. Statistically significant ($p < .05$) two-sided T-test results of mean differences between FS Respondents and HCS Respondents in **bold**.

a: Analyses restricted to the HCS sample because these items were not measured in the FS sample.

FS: Family-focused survey; HCS: Health communication-focused survey; no.: number; h: hours.

highest pandemic job loss (25%) and lowest university employment (23%). The residual category of "other" essential workers perceives the lowest risk of contracting coronavirus at their job (40%), had the lowest pandemic job loss (2%), were the least likely to have increased work hours (4%), and greatest university employment (82%).

Table 3 presents multivariate models predicting health behaviors that include multiple indicators for workers' employment and COVID-19

Table 2
Descriptive statistics by type of worker.

Characteristic	Employment Classification				
	Employed, Not Essential Worker†	Essential Workers‡			
		All	Service	Healthcare	Other
	(N = 590)	(N = 323)	(N = 137)	(N = 74)	(N = 112)
Health Behaviors					
Sleep 8 + hours — no. (%)	216 (37)	90 (28)	36 (26)	24 (32)	30 (27)
Days of exercise in last 7 days	3.74 ± 2.34	3.41 ± 2.32	3.30 ± 2.32	3.42 ± 2.26	3.52 ± 2.37
Days of alcohol drinking in last 30 days	9.88 ± 9.88	8.67 ± 9.29	9.07 ± 9.43	8.68 ± 8.73	8.17 ± 9.51
Number of drinks per session ^a	1.32 ± 1.21	1.23 ± 1.14	1.38 ± 1.28	1.20 ± 0.84	1.08 ± 1.11
Days of tobacco use in the last 30 days ^a	0.29 ± 2.75	1.46 ± 6.19	2.30 ± 7.74	0.00 ± 0.00	1.35 ± 5.90
Perceived Stress^a					
	2.73 ± 0.69	2.66 ± 0.73	2.63 ± 0.68	2.60 ± 0.71	2.74 ± 0.80
COVID-19 Experiences & Perceptions					
Risk of coronavirus exposure at own job — no. (%)	67 (11)	169 (52)	72 (53)	52 (70)	45 (40)
Concern about contracting coronavirus	3.16 ± 0.70	3.17 ± 0.70	3.14 ± 0.71	3.27 ± 0.69	3.14 ± 0.68
Life disrupted	2.25 ± 0.48	2.27 ± 0.54	2.31 ± 0.55	2.26 ± 0.50	2.22 ± 0.55
COVID-19 symptom severity	1.51 ± 0.84	1.65 ± 0.98	1.67 ± 1.01	1.58 ± 0.74	1.68 ± 1.08
State government too lenient — no. (%)	119 (20)	65 (20)	34 (25)	4 (5)	27 (24)
Employment Experiences					
Pandemic-based job loss — no. (%)	34 (6)	47 (15)	34 (25)	11 (15)	2 (2)
Work hours declined by 10 + h — no. (%)	78 (13)	58 (18)	28 (20)	6 (8)	24 (21)
Work hours increased by 10 + h — no. (%)	50 (8)	28 (9)	16 (12)	8 (11)	4 (4)
Work at university — no. (%)	x (71)	147 (46)	32 (23)	23 (31)	92 (82)
Demographic and Social Characteristics					
Age	43.7 ± 12	45.4 ± 13	47.0 ± 13	44.8 ± 12	43.8 ± 12
Feminine gender — no. (%)	405 (69)	212 (66)	92 (67)	56 (76)	64 (57)
Sexual/gender minority — no. (%)	44 (7)	26 (8)	11 (8)	6 (8)	9 (8)
Racial/ethnic minority — no. (%)	55 (9)	28 (9)	8 (6)	7 (9)	13 (12)
Perceived socioeconomic status	7.16 ± 1.44	6.95 ± 1.45	6.70 ± 1.50	7.27 ± 1.33	7.04 ± 1.42

Table 2 (continued)

Characteristic	Employment Classification				
	Employed, Not Essential Worker†	Essential Workers‡			
		All	Service	Healthcare	Other
	(N = 590)	(N = 323)	(N = 137)	(N = 74)	(N = 112)
Partnership & parenthood status — no. (%)					
Co-residential partner, no minor children	259 (44)	142 (44)	55 (40)	38 (51)	49 (44)
No co-residential partner, no minor children	105 (18)	51 (16)	25 (18)	3 (4)	23 (21)
Minor children present	226 (38)	130 (40)	57 (42)	33 (45)	40 (36)
Live with other family — no. (%)	78 (13)	55 (17)	31 (23)	11 (15)	13 (12)

* Plus-minus values are means ± SD.

† Statistically significant ($p < .05$) two-sided test results of mean differences between non-essential workers and all essential workers in **bold**.

‡ Statistically significant ($p < .05$) two-sided test results of mean differences between each essential worker group and the remaining two essential worker groups in **bold**.

a: Analyses restricted to the Health Communications-Focused Survey (HCS) sample ($n = 553$) because these items were not measured in the Family-Focused Survey. In the HCS sample, there are 361 non-essential workers, 192 essential workers, 80 service industry essential workers, 41 healthcare industry essential workers, and 71 “other” essential workers.

no.: number; h: hours.

experiences and sociodemographic control variables. Essential workers are less likely to sleep 8 h ($OR = 0.64; p < .01$) and use tobacco more often ($b = 4.53, p < .01$) than non-essential workers. We next estimate models that disaggregate essential workers by industry to compare their behaviors with non-essential workers. Fig. 1 displays the estimated coefficients and their 95% confidence intervals for each dependent variable. Service industry essential workers are significantly less likely to sleep 8 h relative to all non-essential workers ($b = -0.57, OR = 0.57, p < .05$) and other essential workers ($p < .05$), such that, after setting other model variables to their means, the predicted probability of sleeping 8 h is 24% for service essential workers versus 26%, 31% and 36% for other essential workers, healthcare essential workers and all non-essential workers, respectively. Tobacco use is higher among service ($b = 5.7, p < .01$) and “other” essential workers ($b = 4.2, p < .05$). None of the HCS healthcare essential workers used tobacco.

Other employment experiences often predict health behaviors. Reduced work hours is positively correlated with consuming slightly more alcoholic drinks ($b = 0.25, p < .05$), while increased work hours is positively correlated with slightly more days of alcohol consumption ($b = 0.33, p < .05$) and exercise ($b = 0.57, p < .05$). Pandemic job loss and COVID-19 experiences do not predict health behaviors.

In supplemental models (See Supplemental Table 3), we tested whether the results for essential worker status vary by working at the university, the respondent’s gender, and/or living with one’s children (of any age). University employment did not modify the results. Fig. 2 shows the coefficients for essential worker status when their behavioral patterns differ across gender or parenthood. Essential worker status does not predict exercise frequency for masculine respondents, but it reduces exercise frequency among feminine respondents ($b = -0.57, p < .001$). Because feminine respondents in this sample exercise more frequently, feminine essential workers are predicted to exercise on as many days (3.3) as men (3.3 and 3.6 for non-essential and essential workers,

Table 3
Multivariate regression models of health behaviors by employment experiences and COVID-19 experiences and perceptions.

	Sleep 8+ Hours per Day (=1)		Exercise Frequency (Days)		Alcohol Frequency (Days)		Alcohol Volume (Number of Drinks) ^a		Tobacco Use Frequency (Days) ^a	
	OR	95% CI	b	95% CI	b	95% CI	b	95% CI	b	95% CI
Employment Experiences										
Essential worker	0.64	(0.47 to 0.88)**	-0.25	(-0.56 to 0.06)	-0.16	(-0.33 to 0.01)	-0.08	(-0.24 to 0.08)	4.53	(1.64 to 7.42)**
Pandemic-based job loss	1.50	(0.90 to 2.48)	0.01	(-0.53 to 0.54)	0.17	(-0.12 to 0.46)	0.14	(-0.13 to 0.41)	-04.84	(-10.02 to 0.34)
Work hours declined by 10+ h	1.23	(0.81 to 1.86)	0.43	(-0.00 to 0.86)	0.10	(-0.14 to 0.34)	0.25	(0.03 to 0.46)*	2.56	(-0.25 to 5.38)
Work hours increased by 10+ h	0.72	(0.42 to 1.22)	0.57	(0.04 to 1.10)*	0.33	(0.04 to 0.62)*	0.18	(-0.06 to 0.42)	-4.68	(-10.58 to 1.21)
COVID-19 Experiences & Perceptions										
Life disrupted	0.75	(0.56 to 1.00)	-0.06	(-0.36 to 0.24)	0.03	(-0.13 to 0.19)	-0.07	(-0.23 to 0.10)	-0.88	(-4.12 to 2.36)
COVID-19 symptom severity	0.96	(0.81 to 1.86)	-0.10	(-0.27 to 0.06)	-0.03	(-0.12 to 0.06)	0.07	(-0.01 to 0.15)	0.00	(-0.95 to 0.94)
State government too lenient	1.03	(0.71 to 1.49)	0.03	(-0.35 to 0.41)	-0.12	(-0.33 to 0.09)	-0.17	(-0.37 to 0.03)	-1.38	(-4.72 to 1.96)
N	913		913		913		553		553	

*: p < 0.05; **: p < 0.01; ***: p < 0.001.

Note: Models control for age, feminine gender, sexual/gender minority status, racial/ethnic minority status, perceived socioeconomic status, co-residence with a romantic partner, co-residence with a minor child, and co-residence with another family member.

a: Analyses restricted to the Health Communication Survey sample.

h: hours.

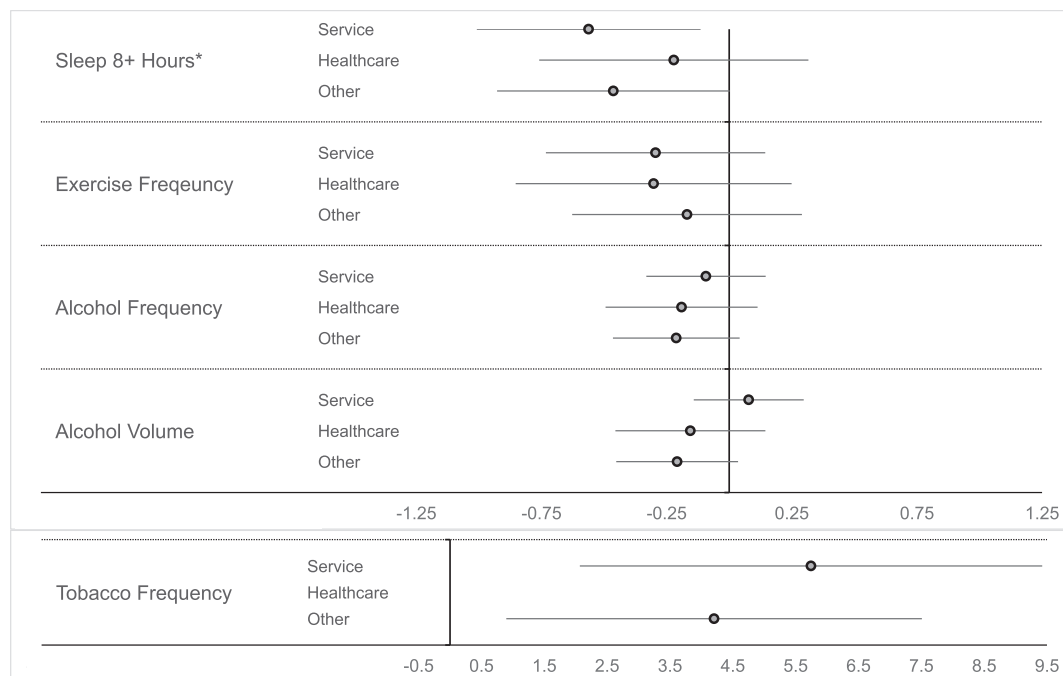


Fig. 1. Coefficient estimates and their 95th percentile confidence intervals from multivariate models predicting health behaviors by type of essential worker. * For consistency across models, we present coefficient estimates. Sleeping 8 or more hours is predicted using a logistic regression model. The odd ratios (OR) for each essential worker category and their 95% confidence intervals are as follows: Service OR = 0.57 [0.36 – 0.89], Healthcare OR = 0.80 [0.47 – 1.37], and Other OR = 0.63 [0.40 – 1.00].

respectively). This gender difference is largely due to reductions in exercise among feminine essential workers in the service industry ($b = -0.69, p < .05$).

Living with one’s children (of any age) modifies the association between essential worker status and sleeping 8 h; essential worker status is only significant for those without co-residential children ($b = -0.74, p < .01$). The predicted probability for sleeping 8 + hours for essential workers not living with children (29%) is comparable to the predicted probability for respondents with co-residential children (averaging 25%) and lower than the predicted sleep duration for non-essential workers without co-residential children (45%; $p < .01$). This parenthood difference is largely due to the lower likelihood of sleeping 8 h among non-parent healthcare industry essential workers ($b = -1.25, OR = 0.30, p < .01$).

Finally, we predict perceived stress in the HCS sample in post-hoc tests (see Supplemental Table 4). As a group, essential workers do not significantly differ in perceived stress, but “other” essential workers have slightly higher perceived stress ($b = 0.02, p < .05$) relative to non-essential workers. Greater pandemic-induced life disruption ($b = 0.14, p < .05$) and viewing the state government response as too lenient ($b = 0.10, p < .05$) are positively associated with perceived stress.

4. Discussion

Our results confirm that unhealthy behaviors during the COVID-19 pandemic vary by essential worker status and work hours. This is consistent with Lin and Ensel’s “life stress” paradigm, which recognizes the effects of stressors and resources on individual health (Ensel and Lin,

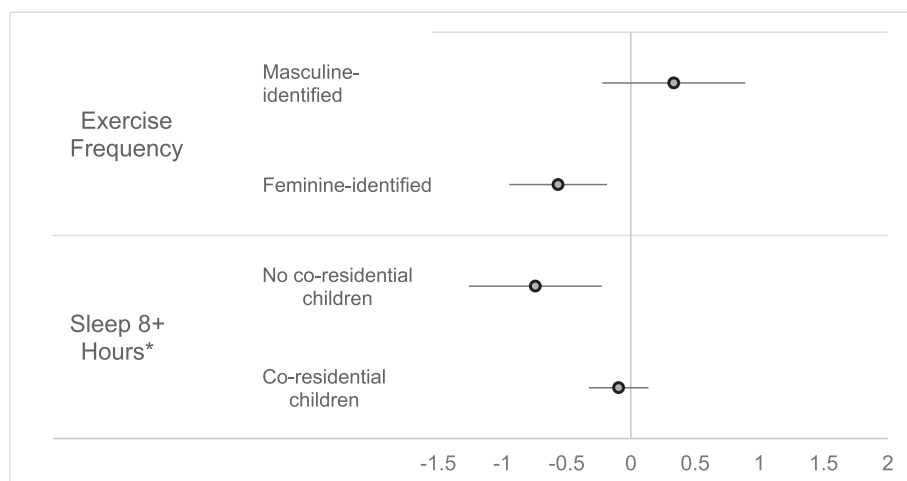


Fig. 2. Coefficient estimates and their 95th percentile confidence intervals for essential workers status across different social groups from statistically significant stratified multivariate models predicting health behaviors. * For consistency across models, we present coefficient estimates. Sleeping 8 or more hours is predicted using a logistic regression model. The odd ratios (OR) for each parent category and their 95% confidence intervals are as follows: Essential worker with no co-residential children OR = 0.48 [0.31 – 0.72] and essential worker with co-residential children OR = 0.91 [0.56 – 1.47].

1991; Lin and Ensel, 1989).

Essential workers in this study use tobacco more frequently and are less likely to sleep 8 h, especially among those in the service industry. These findings are consistent with prior studies showing that tobacco use is more common among those in service and working-class jobs (Barbeau et al., 2004) and those experiencing psychological distress (Jamal et al., 2018), and that US workers in transportation, warehousing, manufacturing and protective service industries have shorter sleep durations (Luckhaupt et al., 2010). In other studies, Italian healthcare essential workers during the COVID-19 pandemic reported an increase in tobacco use (Grandinetti et al., 2021) and Chinese healthcare essential workers during the SARS epidemic reported increased alcohol intake (Wu et al., 2008). US essential workers were significantly more likely to start or increase substance use to cope with the COVID-19 pandemic in April-June 2020 relative to all other adults (Czeisler et al., 2020) and experienced more adverse mental and behavioral health symptoms in September 2020 (Czeisler et al., 2021), while Spanish essential workers had poorer lifestyles overall (Balanzá-Martínez et al., 2021). Irish essential workers slept less during the pandemic because they maintained their pre-pandemic schedules while others slept more (Raman and Coogan, 2022).

Feminine essential workers exercised less frequently, while essential workers not living with children had shorter sleep durations. Prior research finds adults living with minor children sleep less (Krueger and Friedman, 2009) and physical activity was generally lower among US adults during the pandemic (Meyer et al., 2020; Watson et al., 2021). Interestingly, a New Zealand study finds that pandemic-induced daily hassles were correlated with lower physical activity (Hargreaves et al., 2021).

Among all workers in our study, increased work hours are associated with greater exercise and alcohol frequency, while decreased work hours are associated with greater alcohol volume. Our results for alcohol use aligns with studies finding that long work hours increases alcohol frequency and problematic drinking (Gibb et al., 2012; Virtanen et al., 2015) and declining work hours due to economic crises increases drinking volume (de Goeij et al., 2015).

Our results for exercise frequency, however, contradict a prior study that finds increasing work hours are correlated with reductions in physical activity (Biswas et al., 2020). This may reflect differences in the time scale between studies. Biswas et al. evaluated a cohort of workers over a 12 year period, (Biswas et al., 2020) while our study evaluated changes over several months. Physical activity is often episodic – many people begin exercising and stop within a few months (Sherwood and Jeffery, 2000). Perhaps our findings reflect a more transient, initial response of using exercise to cope with stress. Another explanation is the pandemic itself: with leisure- and social-focused businesses shuttered,

workers with increased work hours could have increased their physical activity to release tension. It is unclear if these workers will maintain their higher exercise habits after these businesses reopen.

Our study has several limitations. First, behavioral patterns are self-reported and, thus, subject to recall, response, and social desirability biases. Second, due to the cross-sectional nature of the analysis and limited retrospective information, we cannot determine whether essential workers' observed behavioral differences existed prior to the pandemic. Third, we are precluded from conducting more detailed tests of essential worker status because we do not know non-essential workers' employment industry. Fourth, we could not examine the role of working from home due to substantial item non-response and a strong negative correlation with essential worker status. Fifth, the sample is primarily non-Hispanic white with relatively high socioeconomic status living in a university community; hence even the essential workers are relatively advantaged (McCormack et al., 2020; Roberts et al., 2020). However, community residents may be at a disadvantage if they experience an economic hardship because there are very few social service agencies operating in the county we studied. While these limitations may decrease the generalizability of our data, the observed patterns may be interpreted as lower bounds estimates which may be used to inform healthcare screening and employment policy.

Strengths of our study include its large sample size, the inclusion of multiple validated measures of health behaviors, sufficient samples of healthcare and service industry essential workers, pandemic timing, and numerous sociodemographic control variables to isolate the association of work- and COVID-19-related experiences with health behaviors. Finally, to our knowledge this is the first US study to investigate the association between significant employment changes with health behaviors during a pandemic and compare health behaviors across sectors of essential worker employment.

5. Conclusion

We contribute to the rapidly expanding literature on the COVID-19 by focusing on US workers and their health behaviors – both adaptive and maladaptive – during a time of major disruption. Our analyses confirm prior research findings that healthcare essential workers reported higher substance use during the COVID-19 (McKay and Asmundson, 2020; Grandinetti et al., 2021) and SARS (Wu et al., 2008) pandemics, while expanding data on other health behaviors among essential workers employed in different industries in the US. Finally, we examined the association between changing work hours and job loss for health behaviors, with findings that mirror results documented in the US in the years prior to the COVID-19 pandemic.

While further research is needed to confirm the generalizability of

our results, our data suggest that health behaviors were associated with differential work experiences in the US during the COVID-19 pandemic. To the extent that workers continue to face changing work hours and pandemic-related burdens, these momentary behavioral changes could accumulate and increase health disparities in chronic disease and mortality. Primary care providers would do well to consider essential worker status and changes in work hours as a health risk factor during pandemics.

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CRedit authorship contribution statement

Molly A. Martin: Conceptualization, Methodology, Formal analysis, Writing – original draft. **Robert P. Lennon:** Writing – review & editing. **Rachel A. Smith:** Conceptualization, Data curation, Writing – review & editing. **Jessica G. Myrick:** Writing – review & editing. **Meg L. Small:** Writing – review & editing. **Lauren Jodi Van Scoy:** Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Members of the Data4Action Research Group include leaders representing each internal Pennsylvania State University funding source. Those leaders participated in developing the project concept and methodologies and study design. They were not involved in analysis, interpretation of the data, initial writing, or the decision to submit the report for publication

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2022.101889>.

References

- Balanzá-Martínez, V., Kapczynski, F., de Azevedo Cardoso, T., Atienza-Carbonell, B., Rosa, A.R., Mota, J.C., De Boni, R.B., 2021. The assessment of lifestyle changes during the COVID-19 pandemic using a multidimensional scale. *Revista de Psiquiatria y Salud Mental*. 14 (1), 16–26.
- Barbeau, E.M., Krieger, N., Soobader, M.J., 2004. Working Class Matters: Socioeconomic Disadvantage, Race/Ethnicity, Gender, and Smoking in NHIS 2000. *Am. J. Public Health* 94 (2), 269–278. <https://doi.org/10.2105/AJPH.94.2.269>.
- Biswas, A., Dobson, K.G., Gignac, M.A.M., de Oliveira, C., Smith, P.M., 2020. Changes in work factors and concurrent changes in leisure time physical activity: a 12-year longitudinal analysis. *Occup. Environ. Med.* 77 (5), 309–315. <https://doi.org/10.1136/oemed-2019-106158>.
- Blom, V., Lönn, A., Ekblom, B., Kallings, L.V., Väisänen, D., Hemmingsson, E., Andersson, G., Wallin, P., Stenling, A., Ekblom, Ö., Lindwall, M., Salier Eriksson, J., Holmlund, T., Ekblom-Bak, E., 2021. Lifestyle Habits and Mental Health in Light of the Two COVID-19 Pandemic Waves in Sweden, 2020. *Int. J. Environ. Res. Public Health* 18 (6), 3313.
- Bond, A.E., Wagler, K., Anestis, M.D., 2021. Essential workers: Past month suicidal ideation and COVID-19 stress. *J. Clin. Psychol.* 77 (12), 2849–2859. <https://doi.org/10.1002/jclp.23276>.
- Cadge, W., Lewis, M., Bandini, J., Shostak, S., Donahue, V., Trachtenberg, S., Grone, K., Kacmarek, R., Lux, L., Matthews, C., McAuley, M.E., Romain, F., Snyderman, C., Tehan, T., Robinson, E., 2021. Intensive care unit nurses living through COVID-19: A qualitative study. *J. Nurs. Manag.* 29 (7), 1965–1973.
- Casselmann B, Koeze E. The Pandemic Changed How We Spent Our Time. *The New York Times*. <https://www.nytimes.com/interactive/2021/07/27/business/economy/covid-parenting-work-time.html>. Published July 27, 2021. Accessed September 16, 2021.
- Cohen, S., Kamarck, T., Mermelstein, R., 1983. A Global Measure of Perceived Stress. *J. Health Soc. Behav.* 24 (4), 385–396. <https://doi.org/10.2307/2136404>.
- Czeisler, M.É., Lane, R.I., Petrosky, E., Wiley, J.F., Christensen, A., Njai, R., Weaver, M. D., Robbins, R., Facer-Childs, E.R., Barger, L.K., Czeisler, C.A., Howard, M.E., Rajaratnam, S.M.W., 2020. Mental Health, Substance Use, and Suicidal Ideation During the COVID-19 Pandemic — United States, June 24–30, 2020. *MMWR Morb. Mortal. Wkly Rep.* 69 (32), 1049–1057.
- Czeisler, M.É., Lane, R.I., Wiley, J.F., Czeisler, C.A., Howard, M.E., Rajaratnam, S.M.W., 2021. Follow-up Survey of US Adult Reports of Mental Health, Substance Use, and Suicidal Ideation During the COVID-19 Pandemic, September 2020. *JAMA Netw Open.* 4 (2), e2037665.
- de Goeij, M.C.M., Sturcke, M., Toffolutti, V., van de Mheen, D., Schoenmakers, T.M., Kunst, A.E., 2015. How economic crises affect alcohol consumption and alcohol-related health problems: A realist systematic review. *Soc. Sci. Med.* 131, 131–146. <https://doi.org/10.1016/j.socscimed.2015.02.025>.
- Dogaš, Z., Lušić Kalcina, L., Pavlinac Dodig, I., Demirović, S., Madirazza, K., Valić, M., Pecotić, R., 2020. The effect of COVID-19 lockdown on lifestyle and mood in Croatian general population: a cross-sectional study. *Croat Med J.* 61 (4), 309–318.
- Ensel, W.M., Lin, N., 1991. The Life Stress Paradigm and Psychological Distress. *J. Health Soc. Behav.* 32 (4), 321. <https://doi.org/10.2307/2137101>.
- Folkman, S., Lazarus, R.S., 1980. An Analysis of Coping in a Middle-Aged Community Sample. *J. Health Soc. Behav.* 21 (3), 219–239. <https://doi.org/10.2307/2136617>.
- Gibb, S.J., Fergusson, D.M., Horwood, L.J., 2012. Working hours and alcohol problems in early adulthood. *Addiction* 107 (1), 81–88. <https://doi.org/10.1111/j.1360-0443.2011.03543.x>.
- Grandinetti, P., Gooney, M., Scheibein, F., Testa, R., Ruggieri, G., Tondo, P., Corona, A., Boi, G., Floris, L., Profeta, V.F., G. Wells, J.S.G., De Berardis, D., 2021. Stress and Maladaptive Coping of Italians Health Care Professionals during the First Wave of the Pandemic. *Brain Sci.* 11 (12), 1586.
- Gutiérrez-Pérez, I.A., Delgado-Floody, P., Jerez-Mayorga, D., et al., 2021. Lifestyle and Sociodemographic Parameters Associated with Mental and Physical Health during COVID-19 Confinement in Three Ibero-American Countries. A Cross-Sectional Pilot Study. *Int. J. Environ. Res. Public Health* 18 (10), 5450. <https://doi.org/10.3390/ijerph18105450>.
- Hargreaves, E.A., Lee, C., Jenkins, M., Calverley, J.R., Hodge, K., Houge, M.S., 2021. Changes in Physical Activity Pre-, During and Post-lockdown COVID-19 Restrictions in New Zealand and the Explanatory Role of Daily Hassles. *Front. Psychol.* 12, 410. <https://doi.org/10.3389/fpsyg.2021.642954>.
- Hauser, R.M., Warren, J.R., 1997. Socioeconomic Indexes for Occupations: A Review, Update, and Critique. *Sociol. Methodol.* 27, 177–298.
- Hennekam, S., Ladge, J., Shymko, Y., 2020. From zero to hero: An exploratory study examining sudden hero status among nonphysician health care workers during the COVID-19 pandemic. *J. Appl. Psychol.* 105 (10), 1088–1100. <https://doi.org/10.1037/apl0000832>.

- Horesh, D., Brown, A.D., 2020. Traumatic stress in the age of COVID-19: A call to close critical gaps and adapt to new realities. *Psychol. Trauma: Theor. Res. Pract. Policy* 12 (4), 331–335. <https://doi.org/10.1037/tra0000592>.
- Hu, Z., Lin, X., Chiwanda Kaminga, A., Xu, H., 2020. Impact of the COVID-19 Epidemic on Lifestyle Behaviors and Their Association With Subjective Well-Being Among the General Population in Mainland China: Cross-Sectional Study. *J Med Internet Res.* 22 (8), e21176.
- Ingram, J., Maciejewski, G., Hand, C.J., 2020. Changes in Diet, Sleep, and Physical Activity Are Associated With Differences in Negative Mood During COVID-19 Lockdown. *Front. Psychol.* 11, 588604 <https://doi.org/10.3389/fpsyg.2020.588604>.
- Jamal, A., Phillips, E., Gentzke, A.S., Homa, D.M., Babb, S.D., King, B.A., Neff, L.J., 2018. Current Cigarette Smoking Among Adults — United States, 2016. *MMWR Morb. Mortal. Wkly Rep.* 67 (2), 53–59.
- Knell, G., Robertson, M.C., Dooley, E.E., Burford, K., Mendez, K.S., 2020. Health Behavior Changes During COVID-19 Pandemic and Subsequent “Stay-at-Home” Orders. *Int. J. Environ. Res. Public Health* 17 (17), 6268. <https://doi.org/10.3390/ijerph17176268>.
- Krueger, P.M., Friedman, E.M., 2009. Sleep Duration in the United States: A Cross-sectional Population-based Study. *Am. J. Epidemiol.* 169 (9), 1052–1063. <https://doi.org/10.1093/aje/kwp023>.
- Lantz, P.M., Golberstein, E., House, J.S., Morenoff, J., 2010. Socioeconomic and behavioral risk factors for mortality in a national 19-year prospective study of U.S. adults. *Soc. Sci. Med.* 70 (10), 1558–1566. <https://doi.org/10.1016/j.socscimed.2010.02.003>.
- Lennon, Robert P., Small, Meg L., Smith, Rachel A., Van Scoy, Lauren J., Myrick, Jessica G., Martin, Molly A., the Data4Action Research Group, 2022. Unique predictors of intended uptake of a COVID-19 vaccine in adults living in a rural college town in the United States. *American Journal of Health Promotion* 36 (1), 180–184.
- Lin, N., Ensel, W.M., 1989. Life Stress and Health: Stressors and Resources. *Am. Sociol. Rev.* 54 (3), 382–399. <https://doi.org/10.2307/2095612>.
- Luckhaupt, S.E., Tak, S., Calvert, G.M., 2010. The Prevalence of Short Sleep Duration by Industry and Occupation in the National Health Interview Survey. *Sleep* 33 (2), 149–159. <https://doi.org/10.1093/sleep/33.2.149>.
- Maffoni, S., Brazzo, S., De Giuseppe, R., Biino, G., Vietti, I., Pallavicini, C., Cena, H., 2021. Lifestyle Changes and Body Mass Index during COVID-19 Pandemic Lockdown: An Italian Online-Survey. *Nutrients* 13 (4), 1117.
- Mahalik, J.R., Levine Coley, R., McPherran Lombardi, C., Doyle Lynch, A., Markowitz, A. J., Jaffee, S.R., 2013. Changes in health risk behaviors for males and females from early adolescence through early adulthood. *Health Psychol.* 32 (6), 685–694. <https://doi.org/10.1037/a0031658>.
- Maugeri, G., Castrogiovanni, P., Battaglia, G., Pippi, R., D’Agata, V., Palma, A., Di Rosa, M., Musumeci, G., 2020. The impact of physical activity on psychological health during Covid-19 pandemic in Italy. *Heliyon.* 6 (6), e04315. <https://doi.org/10.1016/j.heliyon.2020.e04315>.
- McCormack, G., Avery, C., Spitzer, A.K.L., Chandra, A., 2020. Economic Vulnerability of Households With Essential Workers. *JAMA* 324 (4), 388–390. <https://doi.org/10.1001/jama.2020.11366>.
- McKay, D., Asmundson, G.J.G., 2020. Substance use and abuse associated with the behavioral immune system during COVID-19: The special case of healthcare workers and essential workers. *Addict. Behav.* 110, 106522 <https://doi.org/10.1016/j.addbeh.2020.106522>.
- Mejia, C., Pittman, R., Beltramo, J.M.D., Horan, K., Grinley, A., Shoss, M.K., 2021. Stigma & dirty work: In-group and out-group perceptions of essential service workers during COVID-19. *Int. J. Hospitality Manage.* 93, 102772 <https://doi.org/10.1016/j.ijhm.2020.102772>.
- Meyer, J., McDowell, C., Lansing, J., Brower, C., Smith, L., Tully, M., Herring, M., 2020. Changes in Physical Activity and Sedentary Behavior in Response to COVID-19 and Their Associations with Mental Health in 3052 US Adults. *Int. J. Environ. Res. Public Health* 17 (18), 6469.
- Mokdad, A.H., Marks, J.S., Stroup, D.F., Gerberding, J.L., 2004. Actual Causes of Death in the United States, 2000. *JAMA* 291 (10), 1238–1245. <https://doi.org/10.1001/jama.291.10.1238>.
- Niedzwiedz CL, Green M, Benzeval M, et al. Mental health and health behaviours before and during the COVID-19 lockdown: Longitudinal analyses of the UK Household Longitudinal Study. *medRxiv*. Published online July 3, 2020:2020.06.21.20136820. doi:10.1101/2020.06.21.20136820.
- Pampel, F.C., Krueger, P.M., Denney, J.T., 2010. Socioeconomic Disparities in Health Behaviors. *Ann. Rev. Sociol.* 36 (1), 349–370. <https://doi.org/10.1146/annurev.soc.012809.102529>.
- Papandreou, C., Arijia, V., Aretouli, E., Tsilidis, K.K., Bulló, M., 2020. Comparing eating behaviours, and symptoms of depression and anxiety between Spain and Greece during the COVID-19 outbreak: Cross-sectional analysis of two different confinement strategies. *Eur. Eating Disord. Rev.* 28 (6), 836–846. <https://doi.org/10.1002/erv.2772>.
- Raman, S., Coogan, A.N., 2022. Effects of societal-level COVID-19 mitigation measures on the timing and quality of sleep in Ireland. *Sleep Med.* 91, 179–184.
- Reynolds, C.M.E., Purdy, J., Rodriguez, L., McAvoy, H., 2021. Factors associated with changes in consumption among smokers and alcohol drinkers during the COVID-19 ‘lockdown’ period. *Eur. J. Public Health.* <https://doi.org/10.1093/eurpub/ckab050>.
- Roberts, J.D., Dickinson, K.L., Koebele, E., Neuberger, L., Banacos, N., Blanch-Hartigan, D., Welton-Mitchell, C., Birkland, T.A., 2020. Clinicians, cooks, and cashiers: Examining health equity and the COVID-19 risks to essential workers. *Toxicol. Ind. Health* 36 (9), 689–702.
- Sawyer, S.M., Afifi, R.A., Bearinger, L.H., Blakemore, S.-J., Dick, B., Ezeh, A.C., Patton, G.C., 2012. Adolescence: a foundation for future health. *The Lancet.* 379 (9826), 1630–1640.
- Sherwood, N.E., Jeffery, R.W., 2000. The Behavioral Determinants of Exercise: Implications for Physical Activity Interventions. *Annu. Rev. Nutr.* 20 (1), 21–44. <https://doi.org/10.1146/annurev.nutr.20.1.21>.
- Singh-Manoux, A., Adler, N.E., Marmot, M.G., 2003. Subjective social status: its determinants and its association with measures of ill-health in the Whitehall II study. *Soc. Sci. Med.* 56 (6), 1321–1333. [https://doi.org/10.1016/S0277-9536\(02\)00131-4](https://doi.org/10.1016/S0277-9536(02)00131-4).
- Smith, Rachel A., Myrick, Jessica G., Lennon, Robert P., Martin, Molly A., Small, Meg L., Van Scoy, Lauren J., the Data4Action Research Group, 2021. Exploring behavioral typologies to inform COVID-19 health campaigns: a person-centered approach. *Journal of Health Communication* 26 (6), 402–412.
- Song, H., McKenna, R., Chen, A.T., David, G., Smith-McLallen, A., 2021. The impact of the non-essential business closure policy on Covid-19 infection rates. *Int. J. Health Econ. Manage.* 21 (4), 387–426.
- Umberson, D., Liu, H., Reczek, C., 2008. Stress and health behaviour over the life course. *Adv. Life Course Res.* 13, 19–44. [https://doi.org/10.1016/S1040-2608\(08\)00002-6](https://doi.org/10.1016/S1040-2608(08)00002-6).
- Valente, J.Y., Sohi, I., Garcia-Cerde, R., Monteiro, M.G., Sanchez, Z.M., 2021. What is associated with the increased frequency of heavy episodic drinking during the COVID-19 pandemic? Data from the PAHO regional web-based survey. *Drug Alcohol Depend.* 221, 108621 <https://doi.org/10.1016/j.drugalcdep.2021.108621>.
- Villadsen A, Patalay P, Bann D. Mental health in relation to changes in sleep, exercise, alcohol and diet during the COVID-19 pandemic: examination of five UK cohort studies. *medRxiv*. Published online March 28, 2021:2021.03.26.21254424. doi: 10.1101/2021.03.26.21254424.
- Virtanen, M., Jokela, M., Nyberg, S.T., et al., 2015. Long working hours and alcohol use: systematic review and meta-analysis of published studies and unpublished individual participant data. *BMJ* 350. <https://doi.org/10.1136/bmj.g7772>.
- Watson, K.B., Whitfield, G.P., Huntzicker, G., Omura, J.D., Ussery, E., Chen, T.J., Fanfair, R.N., 2021. Cross-sectional study of changes in physical activity behavior during the COVID-19 pandemic among US adults. *Int. J. Behav. Nutr. Physical Activity* 18 (1). <https://doi.org/10.1186/s12966-021-01161-4>.
- Wu, P., Liu, X., Fang, Y., et al., 2008. Alcohol Abuse/Dependence Symptoms Among Hospital Employees Exposed to a SARS Outbreak. *Alcohol Alcohol.* 43 (6), 706–712. <https://doi.org/10.1093/alcalc/agn073>.
- Zajacova, A., Jehn, A., Stackhouse, M., Denice, P., Ramos, H., 2020. Changes in health behaviours during early COVID-19 and socio-demographic disparities: a cross-sectional analysis. *Can. J. Public Health* 111 (6), 953–962. <https://doi.org/10.17269/s41997-020-00434-y>.