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Abstract

COVID-19 profoundly impacted the world by causing disruptions in the global job markets due to business closures to support physical distancing in the earliest stages of the pandemic. To maintain basic societal function in the early stages of the pandemic, workers were classified based on the nature of their employment responsibilities as essential (i.e., continued working outside the home) and non-essential (i.e., required to work from home). Using a cross-sectional design, this study identified the lifestyle behaviors (sleep, diet, physical activity) and mood among US workers. An internet-based survey was used to collect data from US adults from April 13 to May 4, 2020. Survey questions focused on sleep, diet, physical activity, mood, grit, mental workload, and hours worked. Descriptive and inferential statistics were used to describe differences in outcomes of interest across a 4-category variable combining sex and essential worker status (i.e., male essential, male non-essential, female essential, and female non-essential). The sample of 631 US adults (mean age = 35.99±12.17) was primarily female (72%), employed full-time (80.5%), and had at least a bachelor's degree (85.8%). Statistically significant differences were observed between groups based on sleep, diet, physical activity, and mood. While sex-based differences were identified between lifestyle factors and moods, both male and female essential workers slept better, were more physically active, and reported better moods than their non-essential counterparts. Findings suggest that sex and work status may have impacted physical and mental health during the earliest stages of COVID-19. The associated long-term consequences of work responsibilities during the earliest stages of the pandemic remain unknown and require further study.

Keywords

COVID-19, employee health, essential worker, sex differences

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Associations of Essential Worker Status, Sex, Lifestyle Behaviors, and Moods: Findings from a Sample of Working Adults in the United States during the Early Stages of the COVID-19 Pandemic

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Abstract

COVID-19 profoundly impacted the world by causing disruptions in the global job markets due to business closures to support physical distancing in the earliest stages of the pandemic. To maintain basic societal function in the early stages of the pandemic, workers were classified based on the nature of their employment responsibilities as essential (i.e., continued working outside the home) and non-essential (i.e., required to work from home). Using a cross-sectional design, we identified the lifestyle behaviors (sleep, diet, physical activity) and mood among workers in the United States. We used an Internet-based survey to collect data from adults April 13 to May 4, 2020. Survey questions focused on sleep, diet, physical activity, mood, grit, mental workload, and hours worked. We calculated descriptive and inferential statistics to describe differences in outcomes of interest across a four-category variable combining sex and essential worker status (i.e., male essential, male non-essential, female essential, and female non-essential). The sample of 631 adults (mean age = 35.99 ± 12.17) was primarily female (72%), employed full-time (80.5%), and had at least a bachelor's degree (85.8%). We found statistically significant differences between groups based on sleep, diet, physical activity, and mood. Whereas we identified sex-based differences between lifestyle factors and moods, both male and female essential workers slept better, were more physically active, and reported better moods than their non-essential counterparts. Findings suggest that sex and work status may have impacted physical and mental health during the earliest stages of COVID-19. The associated long-term consequences of work responsibilities during the earliest stages of the pandemic remain unknown and require further study.

Keywords: COVID-19, employee health, essential worker, sex differences

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Introduction

First diagnosed in December 2019 in China (Wang et al., 2020), the novel coronavirus disease (COVID-19) pandemic profoundly impacted the world. Efforts to slow the pandemic have resulted in the implementation of policies requiring the practice of physical distancing and masking worldwide. This caused unprecedented changes to daily life and social interactions around the globe (Lewnard & Lo, 2020). Physical distancing policies in the United States (U.S.) varied from state-to-state and region-to-region, thereby impacting lifestyles differently around the nation. Although necessary to mitigate the spread of COVID-19 (Greenstone & Nigam, 2020; Lewnard & Lo, 2020), physical distancing required by shelter-in-place and stay-at-home orders undoubtedly led to both positive and negative short- and long-term mental and physical health consequences (Galea et al., 2020; Venkatesh & Edirappuli, 2020) and an increase in mental and physical health issues (Galea et al., 2020; Lee et al., 2007). Many studies have noted psychological distress among people living in China who were affected by the pandemic (Cao et al., 2020; Li et al., 2020; Yao et al., 2020), whereas other studies suggest the COVID-19 pandemic effects transcend psychological distress to impact sleep quality (Huang & Zhao, 2020; Xiao et al., 2020a, 2020b), physical activity (Zhang et al., 2020), and diet (Galanakis, 2020; Long & Khoi, 2020; Loopstra, 2020). These studies highlight the health impacts resulting from the pandemic; however, they do not specifically account for the ways that mental and physical health were influenced by work routine disruption or necessity to keep working to maintain critical functions within their respective communities.

Among working adults, employment status was a primary contributor to the COVID-related lifestyle in that it has introduced abrupt and unforeseen shifts requiring many to work from home and re-balance work-life responsibilities. The pandemic especially disrupted labor markets in the U.S., which required work to be reclassified as essential or non-essential. Essential workers (E) were those whose physical presence at their jobs are essential to the survival and function of their communities (Lancet, 2020). Non-essential workers (N) were those who remain employed but do not meet this critical function (Lancet, 2020). The classification of essential work varied widely by geography, culture, and jurisdiction; however, essential work duties typically included those who provide direct patient care or emergency services (e.g., healthcare, police, fire) and those who work at basic need businesses (e.g., grocers, plumbers, electricians, sanitation specialists) (Lancet, 2020). Regardless of precise definitions, the essential nature of one's job may influence their mental and physical responses to a pandemic. For example, essential workers may experience higher levels of stress and mood disturbances due to a constant threat of viral exposure, whereas non-essential workers may feel safe and secure.

Although many studies have examined the health and wellbeing of essential workers during COVID-19, and shown essential workers exhibited poor physical and mental health during the pandemic (Bell et al. 2021; Chowdhury et al., 2022; Jagroop-Dearing et al., 2022; Hu et al., 2022; Guy et al., 2021; Ramos et al., 2021; Silva et al., 2023; White & Van Der Boor, 2020), no studies specifically compared wellness between essential and non-essential workers. Whereas differences in lifestyle factors and mood between essential and non-essential employees remained unknown during the earliest stages of the pandemic, it is also important to examine lifestyles and moods by sex based on already known differences between males and females during non-COVID-19 times. Sex-related differences in sleep have been established with women more likely to experience insomnia (Zhang & Wing, 2006), have bad dreams (Schredl & Reinhard, 2011), and have more sleep-related complaints (Krishnan & Collop, 2006). Research also suggests that sex-related differences are observed in diet behaviors (Baker & Wardle, 2003; Davy et al., 2006; Li et al., 2012), with women typically consuming higher-quality diets. Additionally, sex differences in physical activity and exercise behavior have been documented with the presence of many sociological, psychological, and demographic barriers for women (Buckworth & Tomporowski, 2013; Kohl & Hobbs, 1998; Malina et al., 2004). In general, women report being less physically active than men (Ussery et al., 2018; Yang et al., 2019). Furthermore, there are clear sex differences with regards to mood, as mood disorders are more prevalent in women than men (Diflorio & Jones, 2010; Kessler, 2003; Kessler et al., 1993; Parker & Brotchie, 2010; Weissman et al., 1993). These sex-related confounding factors exist during “normal” times; however, they might become more or less pronounced during a pandemic, which may be further intensified by the nature of their work and occupational responsibilities.

Given the potential pandemic effects on mental and physical health coupled with work-life disruptions, it is especially important to examine how these factors differ between men and women who left their homes for employment purposes (essential employees) versus those who did not (non-essential employees). The primary purposes of this study were to: (1) describe lifestyle factors and moods among employed persons in the U.S. during the early stages of the COVID-19 pandemic; and (2) identify differences in these lifestyle factors and moods between essential and non-essential male and female workers. At the intersection of sex and work roles, this study aims to add to the understanding about differences in lifestyle behaviors, moods, and work habits of individuals who were considered essential workers compared to those who had the opportunity to work from home.

Methods

Study Design

The data presented in this paper are part of a larger study purposively used to learn more about life, health, and associated changes during the COVID-19 pandemic. Data were cross-sectional obtained from a convenience sample and collected April 13, 2020 to May 4, 2020.

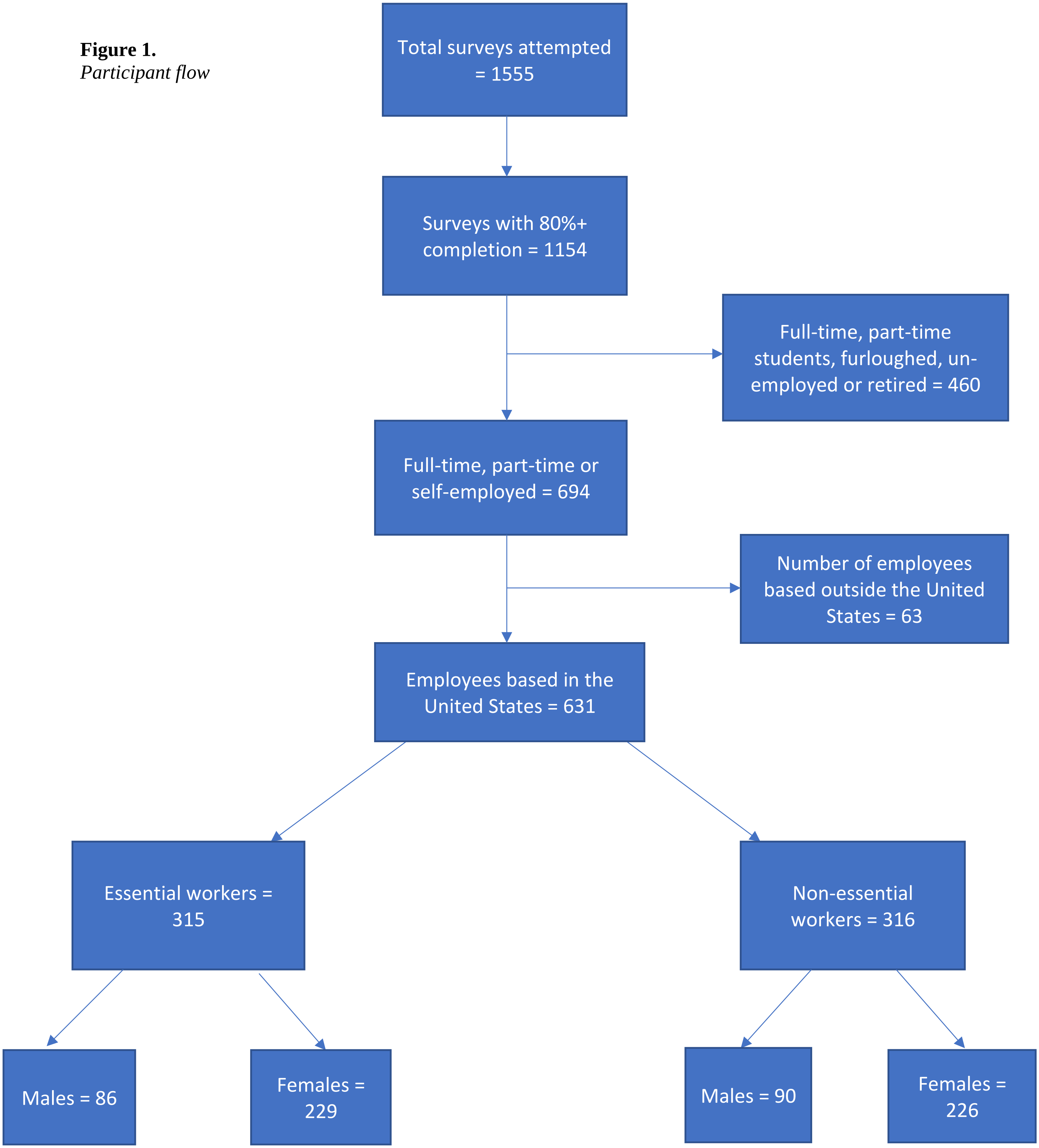
Participants

We recruited participants using the following strategies: (1) campus-wide emails at two universities; (2) snowballing recruitment emails sent to colleagues, friends, and family with requests to forward emails to others; (3) social media posts on Twitter, Facebook and the LinkedIn profiles of the study principal investigators (PIs) and their respective institutions, while asking their social networks to repost; and (4) media publications and promotions by the institutions of the PIs.

We invited participants to complete the baseline questionnaire using Qualtrics software (Qualtrics, XM, Provo, UT). They also were informed that they would receive weekly emails to complete truncated follow-up questionnaires about their lifestyle factors and moods. Participants were informed that for every survey they completed they would be entered into a drawing for a $500 Amazon e-gift card. Because this study is still on-going, no drawings have been completed. As such, we only report baseline questionnaire data.

Figure 1 depicts the CONSORT flow diagram of our study. Over a 20-day period, 1557 participants initiated the Internet-based questionnaire with 1154 completing at least 80% of the survey (74.0%). We reduced the overall number of participants by omitting those who did not report being full-time (n = 559), part-time (n = 95), or self-employed (n = 40), and those who live outside the U.S. (n = 63). The usable sample of 631 was reduced to 533 after the removal of outliers (i.e., data points falling outside the 95% CI of the usable data).

Figure 1.
Participant flow



Demographics

We asked participants to self-identify if they were considered essential employees and had to leave their home to go to their place of employment (yes/no). Based on this binary response, participants were either classified as essential (E) or non-essential employees (N). Additionally, we asked participants to self-report their sex (male, female) as well as their age, education level, relationship status, whether or not they resided with others, and the size of the city/town/area in which they reside. Based on the known risks for COVID-19, participants also self-reported if they knew anyone diagnosed with COVID-19, and whether they had one or more chronic conditions. Table 1 presents the characteristics of study participants.

Instruments

Lifestyle Behaviors

Sleep. Participants responded to the Pittsburgh Sleep Quality Index (PSQI) that assesses sleep quality (Buysse et al., 1989). This 19-item index assesses seven underlying dimensions of sleep: quality, latency, duration, habitual sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction over the last month. Scores for each of the seven dimensions range from 0 to 3 (with 3 being the poorest possible score). For the purposes of this study, we examined the components of sleep latency, sleep disturbance and use of sleep medication, as well as the continuous typical sleep duration (in hours).

Diet. We used the Rapid Eating Activity Assessment for Participants Short Version (REAP-S) to evaluate nutritional status of the participants (Gans et al., 2006; Segal-Isaacson et al., 2004). This 16-item assessment asks about eating behavior and is a rapid validated assessment tool to measure unhealthy eating behavior. The survey is divided into two parts. The first part is a 13-question assessment where participants report the frequency of their food choices (i.e., in an average week, how often do you eat less than 2 servings of vegetables per day?). Items are scored from 1 to 3 (1 = usually/often, 2 = sometimes, 3 = rarely/never). Scores given as “does not apply to me” and responses given as “rarely eat processed meats,” “rarely eat meat, chicken, turkey or fish” and “rarely eat these snack foods” were scored as a 3 (Segal-Isaacson et al., 2004). Scores for those 13 items were then summed with higher scores indicating healthier diets (Johnston et al., 2018). If a participant reported a score of a 1 (usually/often), it was counted as a flag, and all flags were added and reported. Participants with 5 or more flags were categorized as having poor diets, and participants with fewer than 5 flags were categorized as having good diets (Gans et al., 2006; Segal-Isaacson et al., 2004). Each question was also individually evaluated for frequency of consumption with higher categories indicating better eating habits (Segal-Isaacson et al., 2004). The second part of the REAP-S contains three items that measure the desire of the participants to change their diets (not reported in this study).

Physical Activity. We used the International Physical Activity Questionnaire-Short Form (IPAQ-SF) to assess physical activity levels (Craig et al., 2003; Lee et al., 2011). This seven-item scale asks participants to respond to open-ended questions regarding their seven-day recall of physical activity. We asked participants the number of days per week that they performed intense, moderate, and light physical activity as well as the number of hours and minutes per day. We also asked them the number of hours and

Table 1
Demographic characteristics according to gender and essential worker status (expressed as % or means ± SD)

Measure	Male		Female			
	Essential (71)	Non-essential (78)	Essential (195)	Non-essential (189)	χ^2	p
Employment status during COVID						
Full-time employed	79.1%	88.9%	76.0%	86.7%	23.085	.001
Part-time employed	10.5%	6.7%	20.1%	13.3%		
Self-employed	10.5%	4.4%	3.9%	4.6%**		
Number of hours of work per week	40.74 ± 17.39	37.10 ± 18.20	40.57 ± 19.30	35.56 ± 15.46*		.023
Age (yrs)	36.82 ± 13.48	37.31 ± 12.15	35.58 ± 12.54	35.14 ± 10.85		.211
Highest level of education					50.514	<.001
< high school (HS)						
HS	2.3%	1.1%	0%	0.6%		
Education beyond HS	2.3%	0%	1.7%	1.0%		
Associates	12.8%	3.3%	10.0%	7.4%		
Bachelors	7.0%	1.1%	8.3%	5.4%		
Master	45.3%	33.3%	32.8%	36.3%		
Doctorate	20.9%	33.3%	34.5%	33.1%		
	9.3%	27.8%	12.7%	16.2%		
Relationship status					6.339	.706
Married/committed relationship						
Single	64.0%	71.1%	65.9%	71.2%		
Divorced	25.6%	24.4%	22.3%	19.9%		
Less committed relationship	3.5%	2.2%	5.2%	4.0%		
	7.0%	2.2%	6.6%	4.9%		
Living with someone					3.085	.379
Yes	84.9%	84.4%	83.4%	88.9%		
No	15.1%	15.6%	16.6%	11.1%		
Residence					6.877	.866
Major city	11.6%	15.6%	15.5%	15.5%		
Small city	22.1%	17.8%	21.2%	21.2%		
Suburb	24.4%	25.6%	20.4%	20.4%		
Small town	25.6%	25.6%	26.5%	26.5%		
Rural/country	16.3%	15.6%	16.4%	16.4%		
Know someone who has been diagnosed with COVID-19					3.945	.268
Yes						
No	27.9%	29.4%	37.6%	31.0%		
	72.1%	70.6%	62.4%	69.0%		
Chronic medical conditions					4.983	.173
Yes	20.9%	25.6%	32.3%	31.4%		
No	79.1%	74.4%	67.7%	68.6%		

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minutes they were sitting for the week. We calculated the number of minutes of intense, moderate, light activity, and sitting time.

Moods

Mood. We used a modified version of the Profile of Mood Survey-Short Form (POMS-SF) (McNair et al., 2003) to assess six different mood states over the last seven days: energy (vigor), fatigue, tension, depression, anger, and confusion. The POMS-SF was modified to use a Visual Analog Scale (VAS) because a VAS is more sensitive to change (O'Connor, 2004). The components (mood states) and dimensions (i.e., the questions summed to create the mood states) of the POMS-SF was kept the same from the original survey (i.e., depression is the sum of sad, unworthy, discouraged, lonely, and gloomy); however, the components (i.e. sad) were modified from a categorical format (0 = "not at all" to 4 = "Extremely) to the more sensitive VAS scale format that can scale feelings as a continuum (0 = "not at all" to 100 = "most extreme"). Each of the mood states has a modified 500-point range. Among healthy participants the Cronbach's alpha for the POMS-SF has been reported as 0.90 (Curran et al., 1995). For the current study, the modified POMS-SF, had a Cronbach's alpha that ranged from 0.586 to 0.919 (tension/anxiety = 0.872, depression = 0.867, anger = 0.876, fatigue = 0.919, confusion = 0.586, energy = 0.895). Preliminary examination revealed that excluding the statement "efficient" improved the internal reliability of confusion substantially from 0.586 to 0.756; therefore, we chose to use the confusion variable that excluded the statement "efficient." The score of the confusion variable ranges from 0-400.

Energy and Fatigue. We used the Mental and Physical Energy and Fatigue State and Trait scale to measure both trait and state mental and physical energy and fatigue (O'Connor, 2006). The trait scale is a 12-item measure with three items per trait to measure the disposition to experience feelings of mental energy, mental fatigue, physical energy and physical fatigue. The four trait variables inquired about the frequency of usual feelings and responses are collected on a 5-point scale ranging from "never" (0) to "always" (4). Representative statements include "I feel I am full of pep" to "I have feelings of being worn out." The state component had the same 12 items as the trait scale, except it measured intensity of feelings on a 0-(not at all) to 100 (most extreme)-point VAS scale and referred to state over the last seven days. Among healthy adults, the Cronbach's alpha coefficients range from 0.82-0.91 (O'Connor, 2006). For the current data, the Cronbach's alpha coefficients ranged from 0.807 to 0.938 (Trait mental energy= 0.817, Trait mental fatigue = 0.878, Trait physical energy = 0.807, Trait physical fatigue = 0.858, State mental energy = 0.867, State mental fatigue = 0.938, State physical energy = 0.865, State physical fatigue = 0.924).

Personality Traits

Grit. The eight-item grit scale (Grit-S) was used to measure grit, a compound trait comprising of stamina in consistency of interest and perseverance of effort for long-term goals (Duckworth & Quinn, 2009). We asked participants to respond to a series of statements on a five-point scale (1 = Very much like me, 5 = Not like me at all). The consistency of interest aspect of this scale included statements such as "New ideas and projects sometimes distract me from previous ones" and "I often set a goal but later choose to pursue a different one," and perseverance of effort included statements such as "I am a hard worker" and "I finish whatever I begin." Perseverance of effort was reverse coded (1

= Not at all like me, 5 = Very much like me). Higher scores on the Grit-S indicate high trait-level perseverance and passion for long-term goals. The Grit-S has been shown to have a Cronbach's alpha range of 0.73 to 0.83 in healthy adults, with consistency of interest alphas ranging from 0.73 to 0.79 and perseverance of effort alphas ranging from 0.60 to 0.78. For the current data, the overall Cronbach's alpha was 0.798, the consistency of interest alpha was 0.794 and the perseverance of effort alpha was 0.671.

Work Characteristics

Perceived Mental Workload. The perceived mental workload was measured using mental work items from the background information section of the Mental and Physical State and Trait Energy and Fatigue Scale (O'Connor, 2006). The reliability and validity of these items have been supported (Boolani et al., 2017, 2019; Boolani & Manierre, 2019; Maridakis, Herring, et al., 2009; Maridakis, O'Connor, et al., 2009). Data were obtained separately for work and non-workdays using the same scoring rules. Perceived mental workload on workdays was calculated by multiplying the number of days spent working during the COVID-19 pandemic by the typical number of hours of mental work performed on workdays, by the average intensity of mental work performed on those days. Perceived mental intensity was rated using a five-point Likert scale from 1 to 5 with higher scores indicating higher intensity. Thus, participants who perceived average intensity of mental work and completed five hours of mental work per day, five days per week would have a total perceived mental workload on work days of 5 hours x 5 days x 3 intensity = 75 (Boolani et al., 2019; Jansen et al., 2019; P. O'Connor, 2006). Mental workload on non-workdays was calculated by subtracting the number of workdays reported from seven and then multiplied by the number of hours of reported mental work on non-workdays by the perceived mental intensity of the workload. Thus, if a participant stated that they did four hours of mental work at average intensity during the days and they worked five days per week, their mental load on non-work days was calculated by subtracting 5 from 7 (2 days), x 4 hours, x 3 (average intensity) = 24 (Boolani et al., 2019; Boolani & Manierre, 2019; Jansen et al., 2019; O'Connor, 2006).

Number of Hours Worked per Week. Using the background information section of the Mental and Physical State and Trait Energy and Fatigue Scale (O'Connor, 2006), the number of hours of work per week was calculated by multiplying the reported number of days of work per week by the number of hours of spent working on a typical day.

Data Analysis

Preliminary Analysis

All analyses were completed using SPSS 26.0 (IBM Corp. Released 2016. IBM SPSS Statistics for Windows: Armonk, NY). Variables were evaluated for normality of distribution using a combination of histograms and the Shapiro-Wilks test for normality. Vigor (energy), state mental and physical energy, motivation to perform mental and physical tasks were normally distributed. Age, vigorous, moderate, and light physical activity, mental workload on workdays and non-workdays, anxiety, depression, anger, confusion, fatigue, state physical fatigue, and state mental fatigue were positive skewed, and age, trait physical and mental energy and fatigue, time spent sitting, REAP-S, and hours of work were leptokurtotic. To limit the effect of potential outliers, we eliminated participants who were greater than three standard deviations from

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the mean on either side for any of the variables. We used exponential, power, arcsine, and logarithmic transformation techniques; however, none of the transformations resulted in normally distributed data ($p > .05$) and the histograms did not substantially differ from the originals. Because the transformations did not improve normality, we employed large sample theory (Chernoff, 1956; Lehmann, 2004) to use parametric tests, which suggests that non-normal data may be assessed using parametric tests in large samples that may be representative of the population of interest.

Main Analysis

Participants were split into four groups: Male essential workers (ME), male non-essential workers (MN), female essential workers (FE) and female non-essential workers (FN). Descriptive statistics were computed for demographic characteristics, moods, lifestyle behaviors, and work characteristics, which were then compared across the four categories of workers (ME, MN, FE, FN). For continuous variables, we used one-way analysis of variance (ANOVA) tests to determine significant mean differences. We used Tukey's *post hoc* test to identify specific differences between groups. For categorical variables, chi-square tests were used to assess proportional differences across groups. Findings were considered significant if $p < .05$, and a Benjamini-Hochberg False Detection Rate (FDR) of 0.8 was used to control for multiple analyses.

Results

Table 1 provides the demographic characteristics of the sample. Of the 631 employed U.S. adults, the average age was 35.99 (SD = 12.17) years, and 72% were female. Approximately half of male workers and half of female workers were considered essential workers. A majority of the sample reported working full-time (80.5%). Overall, the sample was highly educated, with 85.8% having a bachelor's degree or higher. About 13% of ME and 34% of FE worked directly with patients, respectively. ME within the sample tended to have lower education status compared to all other groups. Both ME and FE were more likely to smoke than their non-essential worker counterparts.

Sleep

Overall, females had poorer scores for sleep latency ($\chi^2(9, N = 533) = 27.34$, $p = .001$), sleep disturbance ($\chi^2(9, N = 533) = 20.909$, $p = .013$) and use of sleep medication ($\chi^2(9, N = 533) = 20.56$, $p = .015$) than males. Among males, ME had better sleep latency scores than MN ($p = .018$).

Diet

FN (29.54 ± 4.22) had significantly higher scores on the REAP-S total score ($F(3, 529) = 2.889$, $p = .035$) compared to ME (31.10 ± 3.78). When examining responses to individual questions on the REAP-S, men were more frequent consumers of meat ($\chi^2(6, N = 533) = 38.183$, $p < .001$) and processed foods ($\chi^2(6, N = 533) = 35.963$, $p < .001$) than women, regardless of essential work status. When accounting for employment status, ME were less frequent consumers of fruits ($p = .002$) and vegetables ($p = .01$) than MN. FE reported being less frequent consumers of vegetables ($p = .049$) compared to FN.

Physical Activity

One-way ANOVAs revealed statistically significant differences between groups for vigorous ($F(3, 529) = 4.719$, $p = .003$) and moderate ($F(3, 529) = 3.691$, $p = .012$) physical activity. *Post hoc* analyses revealed that ME performed significantly more minutes per week of vigorous physical activity than MN (p = .18), FE (p = .015) and FN (p = .002). ME also reported significantly more moderate physical activity compared to FE (p = .031) and FN (p = .007).

Moods

A series of one-way ANOVAs revealed statistically significant differences between groups for anxiety/tension (F(3, 529) = 10.857, p < .001), depression (F(3, 529) = 6.250, p < .001), fatigue (F(3, 529) = 7.374, p < .001), vigor/energy (F(3, 529) = 8.927, p < .001), and total mood disturbance (F(3, 529) = 8.830, p < .001). *Post-hoc* analyses revealed that FE and FN were significantly more anxious than ME (p < .001, p < .001, respectively) and MN (p = .007, p = .003, respectively). FE and FN were also significantly more depressed than ME (p = .004, p < .001, respectively). In addition, FE and FN were significantly more fatigued than ME (p < .001, p < .001, respectively). ME were significantly more energetic than FE (p < .001) and FN (p = .002); however, MN were only significantly more energetic than FE (p = .010). Mood disturbances were also significantly higher in FE compared to ME (p < .001); however, FN had significantly higher mood disturbances compared to both ME (p < .001) and MN (p = .041).

State Energy and Fatigue

A series of one-way ANOVAs revealed statistically significant differences between groups for state physical energy (F(3, 529) = 7.510, p < .001) state physical fatigue (F(3, 529) = 7.009, p < .001), state mental energy (F(3, 529) = 6.346, p < .001), and state mental fatigue F(3, 529) = 6.346, p < .001). *Post-hoc* analyses revealed that ME were significantly more physically and mentally energetic than FE (p < .001, p < .001) and FN (p = .023, p = .008); however, MN were only more significantly physically and mentally energetic than FN (p = .010, p = .034). FE were significantly more physically fatigued than ME (p < .001) and MN (p = .032); however, FN were only significantly more physically fatigued than ME (p = .007). Both FE and FN were significantly more mentally fatigued than ME (p < .001, p = .001, respectively).

Motivation to Perform Mental and Physical Tasks

A one-way ANOVA revealed statistically significant differences between groups for motivation to perform physical tasks (F(3, 529) = 3.682, p = .012). *Post-hoc* analyses revealed that MN were significantly more motivated to perform physical tasks than FE (p = .011).

Mental Work and Number of Hours Worked

There was a statistically significant difference between the self-reported number of hours worked per week (F(3, 529) = 3.937, p = .008), with FE reporting working significantly more hours per week than FN (p = .005).

Trait Energy and Fatigue

ME reported being significantly higher in trait physical energy (F(3, 529) = 5.002, p = .002) than FE (p = .017) and FN (p = .002). FE reported having significantly higher trait physical fatigue (F(3, 529) = 7.056, p < .001) than ME (p = .001) and MN (p = .006); however, FN reported higher trait physical fatigue than ME (p = .15). ME reported being significantly higher in trait mental energy (F(3, 29) = 7.087, p < .001) than FE (p < .001) and FN (p < .001). Conversely, FE and FN reported significantly (F(3, 529) = 8.320, p < .001) higher trait mental fatigue than ME (p < .001, p < .001, respectively).

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Table 2
Physical activity, diet, and sleep according to gender and essential worker status (expressed as % or means ± SD)

Measure	Male		Female		*Post hoc*[1]
	Essential (71)	Non-essential (78)	Essential (195)	Non-essential (189)	
Sleep					
Self-reported sleep duration (hours)	6.87 ± 1.11	7.11 ± 0.95	7.04 ± 1.28	7.18 ± 1.19	
Sleep latency[5]					
0: 1: 2: 3	51: 16: 21:12	41: 29: 27: 3	34: 31: 27: 9	28: 30: 26: 16**	
Sleep disturbance[5]					
0: 1: 2: 3	2: 81: 15: 1	3: 76: 21: 0	3: 59: 37: 1	2: 64: 34: 1*	
Use of sleep medication[5]					
0: 1: 2: 3	77: 5: 12: 7	85: 9: 3: 3	68: 9: 10: 13	69: 13: 7: 11*	
Diet quality					
REAP-S score[2]	29.54 ± 4.22	30.28 ± 4.18	30.62 ± 3.94	31.10 ± 3.78*	FN > ME
REAP-S flags	2.41 ± 2.06	2.12 ± 2.10	2.15 ± 1.92	1.83 ± 1.76	
Good/Poor diet[3]	85: 15	86: 15	87:13	90:10	
Meat servings[4]					
1: 2: 3	37: 34: 29	42: 33: 24	23: 35: 42	16: 31: 52***	
Processed food servings[4]					
1: 2: 3	13: 41: 47	9: 49: 42	5: 28: 68	5: 24: 70***	
Fruit servings[4]					
1: 2: 3	33:43:23	20:31:49	25:38:37	24: 41: 35*	
Vegetables servings[4]					
1: 2: 3	15:47:38	14:27:59	21: 31:49	13: 38: 49*	
Physical activity, min/week					
Vigorous	511.41 ± 960.01	236.02 ± 306.31	273.21 ± 602.63	220.84 ± 403.07**	ME> MN, FE, FN
Moderate	535.41 ± 1254.37	243. 14 ± 312.86	266.98 ± 749.88	219.55 ± 425.08*	ME> FE, FN
Light	554.31 ± 961.79	334.23 ± 347.03	435.35 ± 678.98	360.21 ± 591.18	
Sedentary	2940.78 ± 1759.12	3145.58 ± 1408.45	2793.51 ± 1502.40	3181.69 ± 1763.59	

**p* < .05, ***p* < .01, ****p* < .001
Note.
[1]ME = Male, essential; MN = Male, non-essential; FE = Female, essential; FN = Female, non-essential, [2]Higher scores represent better diet quality, [3]Poor diet ≥ 5 flags, Good diet < 5 flags, [4]Higher categories indicate better eating habits, [5]Higher categories indicate worse sleep or higher use of sleep medication

Table 3

Mood and energy/fatigue characteristics according to gender and essential worker status (expressed as means ± SD)

Measure	Male		Female		*Post hoc*[1]
	Essential (71)	Non-essential (78)	Essential (195)	Non-essential (189)	
Anxiety/Tension	116.03 ± 101.08	137.32 ± 102.02	187.60 ± 118.96	191.71 ± 122.87***	FE> ME, MN FN> ME, MN
Depression	93.86 ± 108.33	124.97 ± 112.48	148.74 ± 118.10	159.24 ± 117.87***	FE> ME FN> ME
Anger	114.86 ± 99.19	135.55 ± 108.13	147.17 ± 107.44	144.25 ± 106.54	
Fatigue	132.72 ± 113.07	163.32 ± 128.70	204.27 ± 133.61	205.29 ± 131.72***	FE> ME FN> ME
Confusion	62.77 ± 52.78	72.94 ± 69.52	75.75 ± 68.33	75.75 ± 68.33	
Vigor	244.39 ± 107.74	222.94 ± 95.41	179.28 ± 102.72	192.52 ± 107.75***	ME> FE, FN MN> FE
Total mood disturbance	275.85 ± 474.08	411.17 ± 495.54	584.26 ± 515.60	594.84 ± 535.69***	FE> ME FN> ME, MN
State physical energy	150.00 ± 70.26	138.12 ± 66.14	109.17 ± 66.93	122.59 ± 71.24***	ME> FE, FN MN> FE
State physical fatigue	77.86 ± 73.95	95.26 ± 72.33	125.16 ± 85.44	114.61 ± 82.63***	FE> ME, MN FN> ME
State mental energy	147.49 ± 73.84	136.06 ± 68.96	110.98 ± 67.90	116.97 ± 67.53***	ME> FE, FN MN> FE
State mental fatigue	78.15 ± 69.52	113.38 ± 83.40	130.10 ± 85.44	124.16 ± 87.81***	FE> ME FN> ME
Motivation to perform mental tasks	58.55 ± 26.91	55.85 ± 24.52	51.58 ± 24.96	51.89 ± 23.00	
Motivation to perform physical tasks	53.69 ± 26.33	57.67 ± 22.92	47.11 ± 25.44	49.43 ± 26.21*	MN> FE
Intensity of mental work on workdays	105.04 ± 75.60	104.69 ± 79.48	106.70 ± 82.89	100.83 75.93	
Intensity of mental work on non-workdays	25.11 ± 49.16	19.99 ± 41.06	19.30 ± 30.75	13.22 ± 14.57*	ME>FN
Energy and fatigue traits					
Trait physical energy	6.94 ±2.41	6.40 ± 2.22	6.01 ± 2.11	5.79 ± 2.39**	ME> FE, FN
Trait physical fatigue	4.20 ± 2.47	4.40 ± 2.09	5.40 ± 2.26	5.15 ± 2.28***	FE> ME, MN FN> ME
Trait mental energy	7.30 ± 2.37	6.65 ± 2.29	6.01 ± 2.29	6.04 ± 2.22***	ME> FE, FN
Trait mental fatigue	3.96 ± 2.14	4.83 ± 5.37	5.37 ± 2.31	5.43 ± 2.36***	FE> ME FN> ME
Grit	3.22 ± 0.57	3.14 ± 0.55	3.19 ± 0.54	3.09 ± 0.55	

*$p < .05$, **$p < .01$, ***$p < .001$ | Note. [1]ME = Male, essential; MN = Male, non-essential; FE = Female, essential; FN = Female, non-essential

Grit

There was no significant difference in grit between groups.

Discussion

In this study, we explored differences in lifestyle and moods among employed adults in the U.S. by sex and essential worker status during the earliest stages of the COVID-19 pandemic. Our findings confirmed sex differences for sleep, diet, physical activity, and mood; however, some differences between essential and non-essential workers were also identified. Non-essential workers generally reported less physical activity, more time spent sitting, and worse mood scores than essential workers. This study provides a nuanced glimpse into the lives of working Americans during the early stages of the COVID-19 pandemic. Sex-based differences were identified between lifestyle factors and moods, which were further gradated by those who were and were not considered essential workers. In some ways, this study may support known sex-based differences in sleep, diet, physical activity, and mood during regular (non-pandemic) times. However, the added layer of worker status generally suggests that both male and female essential workers slept better, were more physically active, and reported better moods than their non-essential counterparts.

Although intuitive, our study findings support previous literature related to sex-differences in health behaviors. For example, in our sample, women reported poorer sleep quality than men, which is generally supported by others studies (Cunningham et al., 2015; Krishnan & Collop, 2006). Additionally, our results align with nationally representative U.S. data, which reports women having better quality diets than men (Hiza et al., 2013; Wang et al., 2014). Interestingly, in this sample, both sexes reported higher than recommended physical activity levels, as a majority of women did not meet recommended physical activity levels pre-COVID-19 (Piercy et al., 2018); however, consistent with prior literature, men were general more physically active than women (Ussery et al., 2018; Yang et al., 2019). Our findings align with other studies published during the pandemic, which report that individuals were more physically active, yet also more sedentary, during the pandemic (Meyer et al., 2020; Smith et al., 2020). Our results also support prior work that women consistently report worse mood states (Boolani et al., 2019; Donner & Lowry, 2013; Kessler, 2003; Manierre et al., 2020) and poorer mood traits (Boolani & Manierre, 2019; Manierre et al., 2020).

Although it is reaffirming that our sample yielded generally known sex-related differences that occur in non-pandemic times, an innovative and informative component of our study was determining whether the essential/non-essential work status exacerbated or attenuated these lifestyle and mood factors. In our study, it is interesting to note that male essential workers had better sleep latency scores, but also reported increased use of sleep medications compared to non-essential workers. This sleep aid use may be attributed to COVID-related factors that contribute to poor sleep quality, particularly increased stress, poor mental health, and changes in routine (Altena et al., 2020). Another interesting finding was that over 85% of our participants were classified as having a good diet during the pandemic. Although speculative, better reported nutrition may be partly attributed to our sample's higher education levels than the general population (Hiza et al., 2013), which may be indicative of more affluence and combat food insecurity (Visser et al, 2020). Furthermore, spending more time at home during physical distancing and shelter-in-place orders could have resulted in better food preparation and more healthful cooking, thereby improving overall diet scores (Wolfson & Bleich, 2015). Of interest is that male essential workers had lower fruit and vegetable intake and higher processed meat intake compared to non-essential workers, which may be attributed to generally poorer eating habits relative to women before and during the pandemic (Mitchel et al, 2020; Rodriguez-Besteiro et al, 2021).

Overall, in our sample, a large proportion of participants met physical activity guidelines, which supports findings from other studies during the pandemic (Meyer et al., 2020; Smith et al., 2020). Male essential workers were significantly more physically active than non-essential male workers and females regardless of essential workers status. Whereas specific job titles were not assessed or analyzed, these results may indicate core differences in the nature of work and associated responsibilities between essential male workers and the remainder of this sample (e.g., more physical labor-oriented jobs associated with infrastructure, transport of goods, warehousing/storage). Additionally in our sample, participants generally spent more time sitting than the average U.S. population prior to the pandemic (7.1 hours vs. 6.4 hours) (Yang et al., 2019), a finding that reinforces other studies about sedentary behavior published during the pandemic (Meyer et al., 2020; Smith et al., 2020). Although differences by essential worker status were not statistically significant, non-essential employees spent more time sitting than essential employees. Female essential workers were closest to the pre-pandemic national average (0.25 hours > pre-pandemic average), and non-essential female employees were spending almost 1.4 hours more sitting than the pre-pandemic nationally reported average (Ussery et al., 2018; Yang et al., 2019). These results suggest that more time in the home and changes in typical routines during the pandemic may have universally changed sitting time and sedentary behavior of individuals in the U.S. Further studies in a more diverse and nationally representative sample of U.S. workers are necessary to improve understanding of the initial and lasting effects of the pandemic.

Given the known role of health behaviors on mood, the observed differences in sleep quality, diet, physical activity, and sitting time in our study may have partially contributed to observed differences in reported mood. Whereas women on average reported poorer moods than men, male essential workers overall reported better moods compared to the other groups. Previous studies report sex-based differences in moods during the early part of the pandemic (Guadagni et al., 2020; Liu et al., 2020); however, our results are unique because they suggest that men who were essential workers reported significantly better moods than all other groups. This may be because only 13% of male essential workers in this sample engaged in direct patient care (vs. 38% of female essential workers), which may reflect they perceived their threat of COVID-19 exposure to be low. Alternatively, better moods may have been attributed to higher perceived self-worth from being seen as essential during this crisis, or better moods may have been attributed to the ability to main their routine (i.e., minimal lifestyle disruptions) and being able to leave the home (i.e., limited feelings of confinement). Additionally, potential explanation for mood differences between male essential workers and other groups is that male essential workers reported greater mental work on non-workdays. Engaging in mental work on non-work days has been shown to improve moods and feelings of fulfillment (Bennett et al., 2018; Boolani et al., 2019). Finally, findings may reinforce what is already known of men, especially blue-collar workers, tending to report negative mood states less frequently (Bird & Rieker, 2008).

As with most research, this study is not without its limitations. First, this study is cross-sectional in nature. Cross-sectional data hinders researchers' ability to infer causal relationships or assess how lifestyle behaviors and moods changed over the course of the pandemic. Second, data were narrowly collected during a two-week period at the beginning of the COVID-19 pandemic, which may not represent the escalation or normalization of lifestyles and moods among these employees as the pandemic progressed over time. Third, due to the convenience and snowball sampling methods we used, our sample may not be representative of the general working population in the U.S. Recruitment through social media may have introduced self-selection bias and limited the researchers' ability to follow-up with participants who did not respond to recruitment efforts or those who started (but did not complete) the survey. Although this sample was recruited from across the U.S., it was not a nationally representative sample. Therefore, findings may not be widely generalizable beyond this sample of employees.

Implications for Health Behavior Research

Findings from this study have practical implications for health behavior research. Although this study only examined lifestyle and mood during the earliest stages of the pandemic, it captures the status of lifestyle and moods among employed Americans at the most disruptive and uncertain time of an unprecedented global crisis. Whereas this initial stage of the pandemic likely resulted in the most dramatic changes in physical and mental health, findings may provide insights into the longer-term health ramifications of essential and non-essential workers in years to come. Moreover, this study can guide future studies to improve understanding of the strengths and weaknesses of participant recruitment, data collection strategies, and data points in future pandemics or grand-scale crises requiring rapid investigation. Although it is beneficial to assess lifestyle and mood differences by sex and/or essential worker status, our study examined these differences in a more nuanced way to identify sex-based differences in the context of essential workers status (or vice versa). Future studies may benefit from these stratified findings. Given essential worker status was defined in the U.S. based on the pandemic, future studies are needed to understand if this definition (and associated roles) exacerbates or attenuates possible sex-based differences in physical and mental health, which may prepare employers and greater society to address worker needs and provide tailored employee supports.

Discussion Questions

During the early stages of the COVID-19 pandemic, describe the differences sleep, diet, physical activity, and mood by sex. Why do you believe these differences existed and what may have caused them to occur?

During the early stages of the COVID-19 pandemic, describe the differences sleep, diet, physical activity, and mood by employment classification (i.e., essential and non-essential workers). Why do you believe these differences existed and what may have caused them to occur?

Ethical Approval

Institutional Review Board (IRB) approval came from Clarkson University (approval #20-5.1) and George Mason University (approval #1592393-1).

Conflict of Interests

The authors have no conflicts of interest to declare.

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