

# Impacts of Working From Home During COVID-19 Pandemic on Physical and Mental Well-Being of Office Workstation Users

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**Objective:** To understand impacts of social, behavioral and physical factors on well-being of office workstation users during COVID-19 work from home (WFH). **Methods:** A questionnaire was deployed from April 24 to June 11, 2020 and 988 responses were valid. Linear regression, multinomial logistic regression and chi-square tests were used to understand factors associated with overall physical and mental health statuses and number of new physical and mental health issues. **Results:** Decreased overall physical and mental well-being after WFH were associated with physical exercise, food intake, communication with coworkers, children at home, distractions while working, adjusted work hours, workstation set-up and satisfaction with workspace indoor environmental factors. **Conclusion:** This study highlights factors that impact workers' physical and mental health well-being while WFH and provides a foundation for considering how to best support a positive WFH experience.

**Keywords:** COVID-19 pandemic, home office, mental well-being, physical well-being, work from home

The COVID-19 pandemic has altered every aspect of our work and life. In response to the national and local containment policies, companies, organizations and institutions encouraged their employees to work remotely at home to stay safe. Work from home (WFH) emerged in the early 2000s, when telecommuting technologies started to develop and workers could WFH to avoid commuting, provide flexibility in schedules, and achieve a better work-life balance.<sup>1,2</sup> During the COVID-19 pandemic, many workers were advised to WFH full time, which redefined the conventional concept of WFH that was typical only for certain types of work, on an occasional basis, or given unique employee circumstances. Many companies believe that WFH will become more common after the pandemic due to the fact that employers have already paid the fixed cost to set up remote work systems for their employees.<sup>3</sup> Companies

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Clinical significance: Factors related to new work and life environments had significant impact on workers' physical and mental well-being during COVID-19 pandemic. A detailed understanding of these factors is instrumental to avoid decreased physical and mental well-being in workers who might start or continue to work from home in the future.

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## Learning Objectives

- Discuss the negative aspects of full-time work from home (WFH) during the COVID-19 pandemic, as well as the potential benefits for employees and employers.
- Summarize the sample characteristics and variables assessed in the survey of workers who had transitioned to WFH.
- Discuss the effects of WFH on physical and mental well-being and the risk and protective factors associated with WFH-related declines in well-being.

are now determining if operational costs could be dramatically decreased by reducing the required office space.<sup>4,5</sup>

In addition to companies seeing benefits of WFH, there are noted direct benefits to employees. Most significantly, WFH saves daily commuting time and offers more flexibility for workers to take care of their families.<sup>1</sup> WFH allows employees to choose working at times when they are most productive, and WFH can be beneficial for avoiding distractions from coworkers, especially in open plan offices.<sup>6</sup> With options to WFH, workers can take a break from their offices and focus on organizing an individualized approach to their work-life balance that can promote a healthier lifestyle, a benefit for both physical and mental health. Finally, workers may have more control of environmental factors when WFH; indoor environmental quality (IEQ) factors (eg, lighting, temperature, humidity, air quality, noise, ergonomics, etc) are important for physical and mental health of workers.<sup>7</sup> Specifically, IEQ factors influence a workers' comfort, which in turn impacts satisfaction.<sup>8</sup> Unlike in conventional offices, where the workspaces are usually arranged by employers, during WFH, workers have full autonomy and the responsibility of setting up their workspaces at home, being able to work in a location at home that may have better IEQ conditions as opposed to being in a fixed cubicle or open-plan offices.<sup>6</sup> In fact, research has found that home offices might provide better air quality conditions compared to traditional offices.<sup>9</sup>

While there are benefits to WFH, numerous negative aspects of full time WFH have also been described. Employees who are at home do not have the opportunity to socialize with colleagues and may have decreased physical movements, such as loss of walking between different meeting locations.<sup>1</sup> Moreover, extended hours of screen exposure due to full time computer work can lead to fatigue, tiredness, headaches and eye-related symptoms.<sup>10</sup> For individuals who live alone, full time WFH without face-to-face interactions and social support everyday could contribute to mental issues such as social isolation and depression.<sup>1,5</sup> For others, blurred work-life boundaries can make it difficult to detach mentally from work<sup>11</sup> which can increase stress and anxiety.<sup>12</sup> A common area of concern in work-life boundaries is balancing work schedules around other family members, where, for some parents, work time becomes "porous"<sup>13</sup> as they might need to take care of house chores and run errands in between their work meetings. In some cases, parents might choose to sacrifice their sleep hours and work at nights or early mornings since these are the only quiet hours where they could concentrate on work and avoid frequent interruptions.<sup>14</sup> Ongoing work-family conflict can lead to emotional exhaustion.<sup>11</sup>

The abrupt shifts to WFH and other factors associated with the COVID-19 pandemic provide a unique context for exploring the

relationship of WFH on physical and mental well-being. Most apparent impacts on health are due to social and behavioral factors. In particular, the extended stay at home mandates during the pandemic may contribute to general depressed and anxious feelings, often leading to changes in routines and eating habits.<sup>15</sup> These changes in physical activities and food intake can interact with other stress related to WFH that together will likely directly impact physical and mental well-being.<sup>16,17</sup> Moreover, these behaviors are likely further impacted for workers who have children, as the closure of schools and day care centers, require working parents to also perform home schooling for their kids, as well as to managing a more chaotic working environment with increased distractions.<sup>18</sup>

In addition to behavioral and social changes, WFH during the COVID-19 pandemic has also highlighted areas of need for the physical space in home office environments. Of note is that not all workers have access to dedicated workstations in their home, which can result in sharing of their workstations, such as with children who have to attend school remotely,<sup>2</sup> setting up make shift desks, such as the dining table,<sup>14</sup> or working in a variety of places throughout the day, such as kitchen counters, sofas, coffee tables and beds. Moreover, during the pandemic, workers can spend longer hours at their desks in the absence of commuting, limited business traveling, and increased use of computers to conduct meetings rather than holding face-to-face meetings at various different physical locations.<sup>9,19</sup> Increase stress due to sharing of workspaces, poor body mechanics due to lack of proper physical workstation, and prolonged sedentary activity can all lead to increased discomfort and pain.<sup>20</sup> Furthermore, unlike office work environments where central heating, ventilation, and air conditioning systems are available, workers may not pay as close attention to managing the IEQ environment at home. Specifically, working in a location that is not designed for work can lead to unsatisfactory IEQ conditions that can have detrimental effects on both physical and mental well-being, while also decreasing overall work performance.<sup>21</sup>

In total, the pandemic has created a new environment for considering both work and home life within the discussion of WFH. A detailed understanding of the factors in this new environment that relate to physical and mental well-being is instrumental to ensuring positive impacts for office workers who might WFH in near future. Specifically, employers and employees alike require insights on how to provide the best work conditions for workers who either decide or are asked to WFH such that negative health impacts are minimized. In this paper, we present findings of a survey that aimed to understand the relationships of many of these social, behavioral, and physical factors on the physical and mental well-being of workers who switching to WFH during the COVID-19 pandemic. The goals of this study were to (1) understand the overall change of physical and mental well-being after WFH, (2) identify how the changes in lifestyle and home environment after WFH influence physical and mental well-being, and (3) investigate how the occupational and home office environments affect physical and mental well-being during full time WFH.

## METHODS

### Participants and Procedure

Data were collected through an online, anonymous questionnaire deployed via Qualtrics from April 24, 2020 to June 11, 2020. Participants were recruited through emails, social media platforms and newsletters, with snowball sampling used to extend the recruitment process. Eligible participants were identified by an initial screening question (inclusion criterion) that asked if the participant spends most of his/her work time at an office desk and had transitioned to WFH due to the COVID-19 pandemic. A total of 1409 responses were received, of which 91 did not meet inclusion criterion and 330 were incomplete, having not responded to at least 25% of the

questions. The questionnaire included a total of 32 Likert-type, categorical, and open-response questions. Participants responded to questions for demographics, lifestyle and home environment factors, occupational environmental factors, and home office environmental factors, as well as information relative to primary dependent variables related to work performance, physical and mental well-being. Data reported here are focused on factors associated with changes in physical and mental well-being; whereas, analysis of data related to work performance are reported elsewhere. Additionally, data obtained from open-response questions were analyzed and are reported separately. The questionnaire was reviewed and approved by the university's institutional review board as exempt research activity due to the anonymous nature of the methods.

## Measures

### Lifestyle and Home Environment

Multiple lifestyle factors were measured using a 5-point Likert-type scale, from 1 (much lower) to 5 (much higher) with 3 indicating the same as prior to WFH. Lifestyle factors included ratings of overall physical activity, such as standing and step count; physical exercise, such as exercise classes, walking, running, biking; overall food intake; "healthy" food intake; and "junk" food intake. Participants reported the number of other people in the home across the following categories: independent adults other than the respondent, dependent adults with special needs or geriatric care, teenage children (13 to 18), school-age children (6 to 12), toddlers (2 to 5), and infants (<2 y). The number of pets (large or small) was also reported. Given significantly skewed data, all counts were categorized as none or at least one.

### Occupational Environment

Participants rated their current communication with coworkers compared to prior circumstances using a 5-point Likert-type scale, from 1 (much lower) to 5 (much higher) with 3 indicating the same level of communication as prior to WFH. The same scale was used for reporting changes in workload expectations and distractions while working. Participants indicated the number of hours they engaged at their workstation during a typical workday before and after transitioning to working at home. The difference in number of hours was calculated by subtracting the prior from the current number of hours at their workstation. Participants indicated (yes or no) if their work schedule was "same as before" or if their routine had changed due to WFH in one or more of the following ways: I have adjusted... "my work hours," "workdays per week," or "duration of time working before doing non-work tasks." Respondents also indicated (yes or no) potential reasons for making adjustments: I have to schedule work hours around others due to... "sharing of resources (eg, computers, internet bandwidth, physical workspace)" or "non-work activities (eg, home schooling, pet care)." Finally, participants indicated (yes or no) if at least one other person is usually present in the same workspace while working from home.

### Home Office Environment

Satisfaction with seven IEQ factors related to the home workspace were rated on a 5-point Likert-type scale from 1 (extremely dissatisfied) to 5 (extremely satisfied). Using Cronbach alpha, interrelated items were identified to reduce individual factors into four IEQ categories. Satisfaction with the visual environment included averages across ratings of natural lighting, electric lighting, and glare. Satisfaction with the thermal environment was the average of ratings for indoor temperature and humidity. Ratings of satisfaction with air quality and noise remained as individual factors. A general description of the physical workstation was obtained by participants selecting from among the choices: "I have a dedicated room for work activities," "I created a dedicated

workspace in a room with other uses," or "I work in a variety of places, rooms, or locations around my home." Participants were asked how they felt about their workstation relative to health, well-being and productivity by responding to multiple items (yes or no) including: (1) workstation set-up is good and requires no adjustments, (2) knowing how to adjust the workstation if necessary, and (3) knowing how the workstation affects health, well-being or productivity. In addition, respondents reported if they had sought professional advice for workstation adjustments.

### Physical and Mental Well-being

Participants reported their physical and mental well-being two ways. As a general measure, participants rated their overall physical and mental well-being relative to their health status prior to WFH on a 5-point Likert-type scale, from 1 (much lower) to 5 (much higher) with 3 indicating the same as before WFH. To explore primary contributors to these ratings, participants indicated what type of new physical and mental health issues they were experiencing. Nine types of physical issues were provided as options: musculoskeletal (discomfort, injury); cardiovascular (chest pains, blood pressure, heart rate); chest/lung (shortness of breath, chest tightness/pain); digestive (appetite changes, abdominal discomfort, irregularity); eye-related (burning, blurry and/or dry); fatigue or tiredness; headaches or migraines; nose/throat related (dry, runny, or bloody nose; hoarseness); and skin related (chapped, itchiness, redness). Eight types of mental health issues were also provided as options: anxiety or nervousness; depression, sadness, or feeling blue; insomnia or trouble sleeping; low motivation or slowed actions; mental stress, rumination, or worry; mood swings; social isolating or decreased interest in social engagement; and trouble concentrating, maintaining attention or focus. As a means for exploring the scope and magnitude of impacts on health, participants were categorized by the number of new physical or mental health issues as none, one issue, or two or more issues.

### Data Analysis

Descriptive statistics were calculated for all lifestyle and home environment, occupational environment, home office environment, and physical and mental well-being variables. Pearson correlation analyses were performed to examine individual associations among all continuous variables, including between the primary outcomes of physical and mental well-being. Meaningful correlations were identified as weak (0.30 to 0.50), moderate (0.50 to 0.70) or strong (>0.70). Independent sample *t* tests were used to test the significance of difference in physical and mental well-being status across groups based on dichotomous questions. Linear regression models were constructed to understand how worker demographics, lifestyle and home environment, occupational environment, and home office environment factors affected overall physical and mental well-being statuses. Modeling was conducted in two steps, first to identify any effects of demographics on the primary outcomes and second to examine effects across all variables while controlling for each demographic factor. All dependent variables were dummy coded. Reference categories for demographic variables were "business and office" for occupation (most frequent category) and "less than 50k" for income (median earnings for full-time workers<sup>22</sup>). The reference category for the multi-level home office environment variable was "I have a dedicated room for work activities" since this is the ideal WFH condition for a workspace. After examining factors related to overall physical and mental well-being, an exploration of potential associations with the number of negative health issues was conducted. Multinomial logistic regression and chi-square tests were used to examine relationships for all continuous and categorical variables, respectively, as predictors for the number of new physical and mental health issues. Statistical analyses were conducted using SPSS v. 26 (IBM) and significance was set at .05.

## RESULTS

### Participant Characteristics

The 988 valid responses were from individuals with an average age of 40.9 (SD = 13.1) years, and gender split of 56.5% female, 32.1% male, and 11.4% who preferred not to say or did not answer. The race or ethnicity of the respondents included Caucasian (60.9%), Asian (24.6%), Hispanic or Latino (9.3%), African American (2.8%), and mixed race or another ethnicity (2.4%). Approximately one-third of respondents reported having either a doctorate (34.1%) or graduate/professional degree (37.2%), while the remaining respondents had either a 4-year degree (22.1%) or a 2-year degree or less (6.5%). Most respondents had an annual income of between \$50k and \$100k (40.6%), with the remainder approximately equally distributed among those making less than \$50k (19.0%), \$100k to \$150k (21.7%), and more than \$150k (18.8%). Respondents worked across a variety of occupations including those in business and office (29.1%), engineering and architecture (24.6%), education and arts (22.1%), healthcare and social services (9.3%), computer sciences and mathematics (8.2%), basic science (4.2%), and service and physical occupations (2.6%). Across these occupational categories, the vast majority of respondents were full-time employees (82.8%), while the remaining respondents were students (8.7%), part-time workers (5.9%), or contractors (2.6%). Responses were primarily received from individuals working in California (47.3%), with additional responses received from 39 other states in the U.S. (35.8%) and countries outside of the U.S. (6.4%), and the remaining 10.5% of respondents preferring not to answer.

### Descriptive Statistics

The average ratings for our dependent variable of overall physical and mental well-being were both decreased as compared to prior to WFH, at 2.84 (SD = 0.87) and 2.70 (SD = 0.93) respectively. Averages and frequencies of responses across all independent variables are reported in Table 1. Lifestyle changes were noted as decreased overall physical activity and physical exercise, combined with increased overall food intake, despite the average amount of healthy and junk food intake remaining about the same across the sample. The vast majority of respondents (84.2%) had another independent adult living with them, while approximately half had a pet (50.2%), and up to 21.5% had at least one dependent or child in the home. As compared to pre-pandemic levels, work expectations and distractions were increased, communication with coworkers was decreased, and the time spent at the workstation increased by approximately 1.5 hours. Nearly three-fourths of participants (73.4%) had adjusted their work hours and more than one-third of participants (37.4%) reported scheduling their work hours around others. Only one-third of respondents (33.0%) had a dedicated room for their work at home, while approximately half of the respondents indicated their workstation was in a space with other uses (50.3%) and that other people are present within the workspace (47.6%). The fewest respondents (16.7%) work in a variety of places around the house, such as couch, bed and dining tables. Respondents were generally satisfied with IEQ factors (all > 3.5); however, less than one-third of respondents indicated having a good workstation set-up, and only 11% of respondents knew if and how their workstation was affecting their health, well-being, or productivity. Of those individuals who indicated knowing how to adjust their workstation, only one-third (32.5%) reported that they had a good workstation set-up.

### Associations Among Individual Variables

Correlations among all continuously rated variables, including the primary outcomes of physical and mental well-being status, are shown in Table 2. Overall physical activity was strongly correlated with physical exercise ( $r = 0.73, P < 0.01$ ) and weakly correlated with communication with coworkers ( $r = 0.30, P < 0.01$ ).

**TABLE 1.** Average (SD) and Frequency (%) Across Responses to Each Individual Variable Within Lifestyle and Home Environment, Occupational Environment, and Home Office Environment

	Number of Responses	Mean (SD) or Frequency (%)
Lifestyle and home environment		
Overall physical activity (eg, standing, step count), [1–5]	883	2.35 (1.37)
Physical exercise (eg, classes, walking, running, biking), [1–5]	884	2.55 (1.41)
Overall food intake, [1–5]	885	3.24 (0.90)
“Healthy” food intake, [1–5]	884	3.07 (0.94)
“Junk” food intake, [1–5]	885	3.05 (1.11)
At least 1 independent adult lives with me, Yes	969	816 (84.2%)
At least 1 dependent adult lives with me, Yes	701	65 (9.3%)
At least 1 teenager lives with me, Yes	722	136 (18.8%)
At least 1 school age child lives with me, Yes	735	158 (21.5%)
At least 1 toddler lives with me, Yes	704	110 (15.6%)
At least 1 infant lives with me, Yes	673	63 (9.4%)
At least 1 pet lives with me, Yes	812	408 (50.2%)
Occupational environment		
Distractions while working, [1–5]	883	3.35 (1.33)
Workload expectations or requirements, [1–5]	884	3.25 (1.03)
Communication with coworkers, [1–5]	883	2.66 (1.31)
Difference in workstation use compared to before working from home, hours	962	1.46 (3.00)
Adjusted work hours or routine, Yes	983	722 (73.4%)
Accommodate work schedule around others, Yes	983	368 (37.4%)
Work schedule is the same as before, Yes	983	198 (20.1%)
Other people are present in the same workspace while working, Yes	939	447 (47.6%)
Home office environment		
Satisfaction with visual environment, [1–5]	988	3.93 (0.83)
Satisfaction with thermal environment, [1–5]	983	4.00 (1.07)
Satisfaction with air quality, [1–5]	985	4.14 (0.84)
Satisfaction with noise, [1–5]	980	3.48 (1.22)
I have a dedicated room for work activities, Yes	960	317 (33.0%)
I have a dedicated space in a room with other uses, Yes	960	483 (50.3%)
I work in a variety of places, rooms, or locations around my home, Yes	960	160 (16.7%)
I have a good workstation set-up, Yes	975	281 (28.8%)
I know how to adjust my workstation, Yes	975	295 (30.3%)
I have consulted a professional to make adjustments to my workstation, Yes	975	23 (2.4%)
I know how my workstation affects my health, well-being or productivity, Yes	975	111 (11.4%)

Rating of 3 on all [1–5] scales indicate levels the same as before working from home or neutral satisfaction.

**TABLE 2.** Correlations Among Individual Lifestyle, Occupational Environment, Environmental Satisfaction, and Physical and Mental Well-Being

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Overall physical activity	—													
2 Physical exercise	<b>0.73**</b>	—												
3 Overall food intake	-0.14**	-0.08*	—											
4 “Healthy” food intake	0.19**	0.24**	-0.19**	—										
5 “Junk” food intake	-0.20**	-0.20**	<b>0.42**</b>	<b>-0.56**</b>	—									
6 Distractions while working	-0.17**	-0.15**	0.19**	-0.12**	0.25**	—								
7 Workload expectations	-0.05	-0.09**	0.05	-0.01	0.07*	-0.01	—							
8 Communication with coworkers	<b>0.30**</b>	0.23**	-0.08*	0.09**	-0.09**	-0.17**	0.21**	—						
9 Visual environment	0.05	0.03	-0.06	0.08*	-0.10**	-0.09**	0.01	0.03	—					
10 Thermal environment	0.08*	0.05	-0.02	0.03	-0.05	-0.12**	-0.01	0.04	<b>0.41**</b>	—				
11 Air quality	0.08*	0.08*	-0.06	0.05	-0.06	-0.07*	-0.03	0.02	<b>0.49**</b>	<b>0.67**</b>	—			
12 Noise	0.08*	0.06	-0.07*	0.08*	-0.08*	-0.22**	-0.07*	0.06	<b>0.33**</b>	<b>0.36**</b>	<b>0.39**</b>	—		
13 Physical well-being	<b>0.50**</b>	<b>0.58**</b>	-0.21**	<b>0.34**</b>	<b>-0.36**</b>	-0.17**	-0.05	0.22**	0.07*	0.05	0.07*	0.07*	—	
14 Mental well-being	<b>0.36**</b>	<b>0.33**</b>	-0.17**	0.21**	-0.28**	<b>-0.30**</b>	-0.04	0.27**	0.14**	0.15**	0.12**	0.20**	<b>0.52**</b>	—

Bold indicates values that have meaningful interpretation as weak, moderate, or strong correlations.

\*\* $P < 0.01$ .

\* $P < 0.05$ .

Junk food intake had a weak positive association with overall food intake ( $r=0.42, P<0.01$ ) and moderately negative association with healthy food intake ( $r=-0.56, P<0.01$ ). Weak to moderate positive correlations were noted among all of the IEQ factors (all  $r>0.30, P<0.01$ ), but no other meaningful associations of IEQ to other factors were noted. Physical and mental health well-being were moderately correlated such that better physical well-being was related to better mental well-being ( $r=0.52, P<0.01$ ). Better physical well-being as compared to prior to WFH was moderately associated with higher physical activity ( $r=0.50, P<0.01$ ) and exercise ( $r=0.58, P<0.01$ ), as well as weakly associated with higher healthy food intake ( $r=0.34, P<0.01$ ) and lower junk food intake ( $r=-0.36, P<0.01$ ). Weak positive associations with mental health status were also noted with increased physical activity ( $r=0.36, P<0.01$ ) and exercise ( $r=0.33, P<0.01$ ), while increased distractions while working was associated with decreased mental well-being ( $r=-0.30, P<0.01$ ).

Differences in the average physical and mental well-being status between groups were small between groups in all dichotomous questions. The largest and only difference approaching a meaningful difference in physical well-being status was between respondents who reported knowing how to adjust their workstation (2.93, SD = 0.87) and respondents who do not indicate having such knowledge (2.80, SD = 0.87;  $P=0.04$ ). A similar small, but statistically significant difference was noted in mental well-being between respondents who reported knowing versus not knowing how to adjust their workstation (2.84, SD = 0.96; 2.65, SD = 0.91;  $P<0.01$ ), as well as for individuals who reported having versus not having a good workstation set-up (2.83, SD = 0.82; 2.66, SD = 0.97;  $P=0.01$ ). Numerous additional statistically significant differences in mental well-being were noted. The average mental well-being status for respondents who adjusted their work hours was lower (2.65, SD = 0.95) than respondents who did not adjust their work hours (2.86, SD = 0.87;  $P<0.01$ ). Similarly, reduced mental well-being was noted for individuals who reported needing to schedule work hours around others (2.59, SD = 0.95) compared to respondents who were not impacted by other individuals (2.77, SD = 0.92;  $P<0.01$ ). Conversely, the average mental well-being status of respondents who reported having somebody present in the same workspace while working from home (2.64, SD = 0.95), was slightly but significantly lower ( $P=0.04$ ) than respondents who reported having a solitary work environment (2.78, SD = 0.90).

### Regression Analysis for Physical and Mental Well-being

Results of the two-step linear regression analyses for factors affecting physical and mental well-being status are shown in

Tables 3 and 4. An annual income of 50k to 100k as compared to less than 50k per year was the only factor significantly associated with either outcome; specifically, a 50k to 100k salary range was predictive of higher mental well-being. Combining all variables resulted in a strong significant model for predicting overall physical well-being ( $F(38, 350) = 11.462, P<0.001, R^2 = 0.561$ ). Improved well-being was predicted by higher levels of physical exercise, healthy food intake, and communication with coworkers; lower levels of overall food intake and junk food intake; and positively affected by having a toddler at home. Improved mental well-being ( $F(38, 351) = 5.306, P<0.001, R^2 = 0.371$ ) was similarly predicted by increased physical exercise, increased communication with coworkers, and decreased junk food intake, along with being positively affected by having an infant in the home and negatively affected by increased distractions while working.

### Exploration of Associations with the Number of Physical and Mental Health Conditions

Approximately two-thirds (64.8%) of respondents reported new physical health issues and approximately three-fourths (73.6%) of participants reported new mental health issues arising since WFH. Two or more new physical health issues were reported by 41.7% of respondents compared to 23.1% who reported one new physical health issue. A majority (55.1%) of respondents reported experiencing two or more new mental health issues, while one new mental health issue was reported by 18.5% and no new issues were reported by 26.4% of respondents. Factors associated with increased numbers of new physical or mental health issues were generally similar (Tables 5 and 6) and tracked with overall rating of physical and mental well-being. Female respondents and those in the lowest two income groups (ie, annual salary <50k and 50k to 100k) reported having new issues in two or more categories more frequently than males and those in higher salary categories. Increased physical activity, exercise, and healthy food intake, along with lower junk food intake were all associated with fewer issues; while, increased overall food intake was associated with more physical and mental health issues.

Multiple additional factors were associated with the number of physical and mental health issues in ways not associated with overall well-being status. A statistically significant predictor that was novel to this analysis was that living with at least 1 teenager lowered the chance of reporting new issues, while living with at least 1 toddler increased the chance of reporting new health issues. Moreover, despite having an infant at home predicting better overall mental well-being, having an infant was associated with reporting of one new mental health issue. Additionally, respondents who had to adjust their work hours, schedule work around others, and had more

**TABLE 3.** Relationship of Demographic Variables to Physical and Mental Well-Being Status

	Physical Well-Being		Mental Well-Being	
	<i>b</i>	SE	<i>b</i>	SE
Age	0.01	0.00	0.00	0.01
Gender	-0.02	0.10	-0.02	0.11
Architecture and engineering	0.14	0.12	0.23	0.13
Education and Arts	-0.08	0.11	-0.07	0.12
Computers and mathematics	0.09	0.17	0.14	0.18
Healthcare and social services	0.13	0.14	0.04	0.15
Service and physical occupations	-0.22	0.19	-0.02	0.21
Sciences	-0.03	0.19	0.28	0.21
50k to 100k	0.02	0.13	<b>0.32*</b>	0.14
100k to 150k	-0.04	0.15	0.21	0.16
More than 150k	-0.06	0.18	0.34	0.19

\* $P<0.05$ ; physical well-being ( $F(10, 378) = 0.690, P = 0.749, R^2 = 0.020$ ); mental well-being ( $F(10, 379) = 1.382, P = 0.179, R^2 = 0.039$ ).

**TABLE 4.** Regression Model for Independent Variables on Physical and Mental Well-Being Status

Demographics	Physical Well-Being		Mental Well-Being	
	b	SE	b	SE
Age	0.00	0.00	0.00	0.00
Gender	-0.02	0.07	0.00	0.10
Architecture and engineering	0.07	0.09	0.11	0.11
Education and arts	0.01	0.08	0.07	0.11
Computers and mathematics	-0.02	0.12	0.06	0.16
Healthcare and social services	0.09	0.10	0.03	0.13
Service and physical occupations	-0.25	0.14	-0.03	0.18
Sciences	-0.08	0.14	0.26	0.18
50k to 150k	-0.12	0.10	<b>0.27*</b>	0.12
100k to 150k	-0.15	0.11	0.22	0.15
More than 150k	-0.01	0.13	<b>0.39*</b>	0.17
Lifestyle and home environment				
Overall physical activity (eg, standing, step count)	0.05	0.03	0.07	0.04
Physical exercise (eg, classes, walking, running, biking)	<b>0.34***</b>	0.03	<b>0.16***</b>	0.04
Overall food intake	<b>-0.09*</b>	0.04	-0.03	0.05
“Healthy” food intake	<b>0.12**</b>	0.04	-0.06	0.06
“Junk” food intake	<b>-0.1**</b>	0.04	<b>-0.17***</b>	0.05
At least 1 independent adult lives with me	-0.01	0.09	0.04	0.12
At least 1 dependent adult lives with me	0.01	0.14	-0.24	0.18
At least 1 teenager lives with me	-0.09	0.11	0.15	0.14
At least 1 school age child lives with me	0.00	0.11	0	0.14
At least 1 toddler lives with me	<b>0.25*</b>	0.12	0.04	0.16
At least 1 infant lives with me	0.24	0.14	<b>0.45*</b>	0.18
At least 1 pet lives with me	0.02	0.07	0.01	0.09
Occupational environment				
Distractions while working	-0.03	0.03	<b>-0.15***</b>	0.03
Workload expectations or requirements	-0.03	0.03	-0.03	0.04
Communication with coworkers	<b>0.06*</b>	0.03	<b>0.1**</b>	0.03
Difference in workstation use compared to before WFH	0.01	0.01	-0.01	0.02
Adjusted work hours or routine	0.07	0.11	0.1	0.14
Accommodate work schedule around others	0.06	0.08	-0.16	0.10
Work schedule is the same as before	0.13	0.12	0.23	0.15
Other people are present in the same workspace while working	-0.06	0.07	-0.06	0.09
Home office environment				
Satisfaction with visual environment	0.04	0.05	0.07	0.06
Satisfaction with thermal environment	-0.03	0.04	0.05	0.06
Satisfaction with air quality	-0.01	0.06	-0.04	0.07
Satisfaction with noise	0.05	0.03	0.02	0.04
I have a dedicated space in a room with other uses	0.13	0.08	0.03	0.10
I work in a variety of places, rooms, or locations around my home	0.01	0.10	-0.08	0.13
I have a good workstation set-up	0.04	0.08	-0.07	0.10
I know how to adjust my workstation	0.04	0.07	0.04	0.09

\*P &lt; 0.05.

\*\*P &lt; 0.01.

\*\*\*P < 0.001; physical well-being ( $F(38, 350) = 11.462, P < 0.001, R^2 = 0.561$ ); mental well-being ( $F(38, 351) = 5.306, P < 0.001, R^2 = 0.371$ ).

distractions were more likely to report 2 or more new physical or mental health issues. Respondents who had a dedicated room for their workstation and reported having a good workstation set-up had fewer new issues, while increased time spent at the workstation, higher workloads, and lack of knowledge for adjusting the workstation were all associated with new physical issues, but not with new mental health issues. Finally, higher satisfaction with workspace IEQ factors reduced the chance of respondents reporting new physical or mental health issues.

## DISCUSSION

We aimed to examine the effect of lifestyle, home, and occupational factors on physical and mental well-being in individuals who had transitioned to WFH due to the COVID-19 pandemic. Our results indicate overall decreased physical and mental well-being status and an increased number of physical and mental health issues following the transition to WFH. Reduced

physical well-being was moderately correlated with reduced mental well-being, each directly impacted by gender and income level. Additionally, both statuses were primarily predicted by lifestyle factors, such as physical activity and eating habits, and social aspects of WFH including who is living in the home, distractions while work, and communication with co-workers. The number of new health issues was associated with various physical aspects of the home workspace.

Female workers and workers with annual salary less than 100k reported having two or more new physical and mental issues more often than male workers and workers with higher income. Our finding aligns with another recent survey which noted that female workers have a higher risk of depression while WFH during the pandemic.<sup>23</sup> Working from home may be more challenging for women, since females tend to be more responsible for household chores and other home activities, and working mothers can feel double the pressure at home due to lack of support with home

**TABLE 5.** Relationships Between Independent Variables and the Number of New Physical Health Issues Reported Since Transitioning to Working from Home

	0	1	2 or More
Demographics			
Age	Ref	<b>B = -0.018*</b>	B = -0.012
Gender***			
Male	<b>44.2%</b>	27.4%	28.4%
Female	27.9%	21.1%	<b>51.0%</b>
Income*			
Less 50k	30.0%	24.0%	<b>46.0%</b>
50k to 100k	29.1%	21.9%	<b>49.1%</b>
100k to 150k	36.8%	25.1%	38.0%
More than 150k	<b>41.9%</b>	23.6%	34.5%
Lifestyle and home environment			
Overall physical activity (eg, standing, step count)	Ref	<b>B = -0.128*</b>	B = -0.354***
Physical exercise (eg, classes, walking, running, biking)	Ref	B = -0.112	<b>B = -0.324***</b>
Overall food intake	Ref	<b>B = 0.248*</b>	<b>B = 0.283***</b>
“Healthy” food intake	Ref	B = -0.137	<b>B = -0.220**</b>
“Junk” food intake	Ref	<b>B = 0.206*</b>	<b>B = 0.327***</b>
At least 1 independent adult lives with me	Ref	B = 0.497	B = -0.174
At least 1 dependent adult lives with me	Ref	B = 0.160	B = -0.462
At least 1 teenager lives with me	Ref	B = -0.229	<b>B = -0.601**</b>
At least 1 school age child lives with me	Ref	B = -0.023	B = 0.010
At least 1 toddler lives with me	Ref	<b>B = 0.671*</b>	B = 0.097
At least 1 infant lives with me	Ref	B = 0.237	B = -0.360
At least 1 pet lives with me	Ref	B = -0.102	B = -0.137
Occupational Environment			
Distractions while working	Ref	<b>B = 0.148*</b>	<b>B = 0.174**</b>
Workload expectations or requirements	Ref	B = 0.031	<b>B = 0.295***</b>
Communication with coworkers	Ref	B = -0.055	B = -0.071
Difference in workstation use compared to before WFH	Ref	B = 0.009	<b>B = 0.124***</b>
Adjusted work hours or routine***			
No	<b>43.1%</b>	24.7%	32.2%
Yes	32.2%	22.7%	<b>45.1%</b>
Accommodate work schedule around others *			
No	<b>37.7%</b>	23.4%	38.9%
Yes	30.7%	22.9%	<b>46.4%</b>
Other people are present in the same workspace while working	Ref	B = 0.220	<b>B = 0.428**</b>
Home office environment			
Satisfaction with visual environment	Ref	<b>B = -0.364***</b>	<b>B = -0.670***</b>
Satisfaction with thermal environment	Ref	<b>B = -0.186*</b>	<b>B = -0.391***</b>
Satisfaction with air quality	Ref	<b>B = -0.311**</b>	<b>B = -0.604***</b>
Satisfaction with noise	Ref	<b>B = -0.306***</b>	<b>B = -0.509***</b>
I have a dedicated room for work activities	Ref	<b>B = -0.390*</b>	<b>B = -0.812***</b>
I have a dedicated space in a room with other uses	Ref	B = 0.159	<b>B = 0.375*</b>
I work in a variety of places, rooms, or locations around my home	Ref	B = 0.420	<b>B = 0.636**</b>
I have a good workstation set-up *			
No	25.5%	24.1%	<b>50.4%</b>
Yes	<b>59.0%</b>	20.9%	20.1%
I know how to adjust my workstation *			
No	32.2%	24.5%	<b>43.3%</b>
Yes	<b>42.0%</b>	20.1%	37.9%

\*P &lt; 0.05.

\*\*P &lt; 0.01.

\*\*\*P &lt; 0.001.

schooling and taking care of children.<sup>19</sup> Similarly, individuals with lower income often lack job security, something that has been made even more tentative during the pandemic, which can directly increase anxiety and manifest as other physical and mental health issues.<sup>24</sup>

The contributing effects of various lifestyle factors on physical and mental well-being is consistent with prior findings in the literature. On average, respondents reported decreased overall physical activity and exercise, which may have been due to stay-at-home restrictions and overall disruptions of individual routines. However, regular physical activity can boost the body's metabolism

and circulation, as well as release endorphins and other positive hormones, all of which is beneficial for both physical health and mental well-being.<sup>25</sup> Even though restricted from many activities, continuing moderate exercise while WFH, such as walking, take active short breaks, and playing with children, can be beneficial for health and well-being.<sup>17,26</sup>

While participants tended to report decreased physical activity, there was only a slight increase in overall food intake with essentially no change in the amount of junk food or healthy food that our respondents reported eating on average. However, decreased physical and mental well-being was noted in those individuals that

**TABLE 6.** Relationships Between Independent Variables and the Number of New Mental Health Issues Reported Since Transitioning to Working From Home

	0	1	2 or More
Demographics			
Age	Ref	$B = -0.005$	<b><math>B = -0.030^{***}</math></b>
Gender**			
Male	<b>35.9%</b>	21.5%	42.6%
Female	20.9%	16.8%	<b>62.3%</b>
Income***			
Less 50k	16.2%	17.6%	<b>66.2%</b>
50k to 100k	24.5%	16.3%	59.2%
100k to 150k	32.1%	16.1%	51.8%
More than 150k	<b>31.9%</b>	25.7%	42.4%
Lifestyle and home environment			
Overall physical activity (eg, standing, step count)	Ref	$B = -0.061$	<b><math>B = -0.222^{***}</math></b>
Physical exercise (eg, classes, walking, running, biking)	Ref	$B = 0.015$	<b><math>B = -0.186^{**}</math></b>
Overall food intake	Ref	$B = 0.175$	<b><math>B = 0.214^*</math></b>
“Healthy” food intake	Ref	$B = -0.097$	<b><math>B = -0.260^{**}</math></b>
“Junk” food intake	Ref	$B = 0.199^*$	<b><math>B = 0.347^{***}</math></b>
At least 1 independent adult lives with me	Ref	$B = 0.145$	$B = -0.0160$
At least 1 dependent adult lives with me	Ref	$B = -0.666$	$B = -0.263$
At least 1 teenager lives with me	Ref	<b><math>B = -0.686^*</math></b>	<b><math>B = -0.609^{**}</math></b>
At least 1 school age child lives with me	Ref	$B = -0.195$	$B = 0.035$
At least 1 toddler lives with me	Ref	<b><math>B = 0.965^*</math></b>	<b><math>B = 1.100^*</math></b>
At least 1 infant lives with me	Ref	<b><math>B = 0.863^*</math></b>	$B = 0.472$
At least 1 pet lives with me	Ref	$B = 0.237$	$B = 0.174$
Occupational environment			
Distractions while working	Ref	<b><math>B = 0.285^{***}</math></b>	<b><math>B = 0.326^{***}</math></b>
Workload expectations or requirements	Ref	$B = 0.031$	$B = 0.059$
Communication with coworkers	Ref	$B = -0.061$	$B = -0.051$
Difference in workstation use compared to before WFH	Ref	$B = 0.000$	$B = 0.030$
Adjusted work hours or routine***			
No	<b>36.2%</b>	18.5%	45.3%
Yes	23.0%	18.3%	<b>58.7%</b>
Accommodate work schedule around others *			
No	<b>31.7%</b>	17.5%	50.9%
Yes	17.5%	19.9%	<b>62.6%</b>
Other people are present in the same workspace while working	Ref	$B = 0.332$	$B = 0.314$
Home office environment			
Satisfaction with visual environment	Ref	<b><math>B = -0.488^{***}</math></b>	<b><math>B = -0.711^{***}</math></b>
Satisfaction with thermal environment	Ref	$B = -0.190$	<b><math>B = -0.433^{***}</math></b>
Satisfaction with air quality	Ref	<b><math>B = -0.254^*</math></b>	<b><math>B = -0.511^{***}</math></b>
Satisfaction with noise	Ref	<b><math>B = -0.433^{***}</math></b>	<b><math>B = -0.620^{***}</math></b>
I have a dedicated room for work activities	Ref	<b><math>B = -0.480^*</math></b>	<b><math>B = -0.814^{***}</math></b>
I have a dedicated space in a room with other uses	Ref	$B = 0.168$	<b><math>B = 0.360^*</math></b>
I work in a variety of places, rooms, or locations around my home	Ref	<b><math>B = 0.619^*</math></b>	<b><math>B = 0.765^{**}</math></b>
I have a good workstation set-up*			
No	17.8%	18.6%	<b>63.7%</b>
Yes	<b>47.7%</b>	18.6%	33.7%
I know how to adjust my workstation			
No	25.6%	18.1%	56.3%
Yes	28.0%	19.7%	52.3%

\* $P < 0.05$ .\*\* $P < 0.01$ .\*\*\* $P < 0.001$ .

reported increased overall food intake or increased junk food intake. These findings follow the previous research that eating unhealthy foods is significantly associated with stress and depressive symptoms.<sup>27</sup> Moreover, increase in food take, especially junk food, can result in weight gain and other physical health issues, such as fatigue and digestive symptoms.<sup>10</sup> While decreased mental well-being can be predicted by eating habits, it is likely that anxiety and stress due to the pandemic or other WFH factors was in fact a contributing factor to increased snacking or cravings for junk food.<sup>15</sup>

In addition to the pandemic contributing to a shift in behaviors, the stay-at-home orders also led to a unique WFH situation for

individuals who live with others. Having an infant at home predicted better overall mental well-being but was also related to a higher chance of reporting one new mental health issue. Similarly, having a toddler at home was a positive predictor of physical well-being but was also associated with more physical and mental health issues. It is reasonable that working parents were having better physical and mental well-being status since they were spending more time at home with their kids; however, a simultaneous increase in new physical and mental issues is likely due to the work-life strain caused by increased distractions and a lack of support from day care centers or babysitters during working hours.<sup>2</sup> This relationship may

be informed by our data that indicate increased distractions were associated with reporting two or more new physical or mental health issues. In fact, previous research found that it is difficult to minimize distractions from children while WFH, and it is recommended to have a separate environment for WFH, especially for demanding work tasks.<sup>28</sup> Our data further support this inter-relationship among variables, as we found that living with at least one teenager lowered the chance of experiencing new health issues. While teenagers can certainly be a source of distraction, they are much more independent, require less supervision, and can assist in household duties.<sup>29</sup>

Beyond the individual lifestyle and home environment, numerous additional considerations related to the work and physical workspace were important contributors to physical and mental well-being. Under normal circumstances, sufficient communication with coworkers can ensure workers are active participants in decision making,<sup>11</sup> can provide opportunities to take breaks from work,<sup>1</sup> and can be a source of social support.<sup>30</sup> Together, promoting effective communication among co-workers can help to maintain a better mental health status,<sup>31</sup> thus it follows that decreased communication with coworkers in our sample was a significant predictor of decreased well-being.

In addition to changes in communication with co-workers, the respondents reported a higher workload and increased time spent at the workstation, both of which were associated with new physical issues. A previous study showed that the average length of a workday has been longer (+48.5 min) and the number of meetings per person has increased 12.9% since WFH.<sup>9</sup> Consecutive online meetings make it difficult for workers to take health breaks between meetings and at the same time increases the intensity of their work. These intense and extended hours at the workstation without proper breaks might be directly linked to increased musculoskeletal discomfort and other negative physical health effects.<sup>1</sup> Furthermore, respondents who had to adjust their work hours or schedule work around others were more likely to report multiple new physical or mental health issues. Although flexibility may be seen as a benefit of traditional WFH, the abrupt shift and other pandemic-related factors likely increased the challenges faced in addressing work-life boundaries among numerous other stressors in attempting to schedule work time.<sup>1</sup>

Finally, there are multiple considerations for the health impacts of the physical workspace in a WFH environment. Specifically, having a dedicated room for work, having an ergonomically correct workstation, knowledge of how to adjust a workstation, and increased satisfaction with IEQ factors in the workspaces were associated with lower chance of experiencing new health issues. Working in a dedicated room minimizes the chance of being distracted and interrupted,<sup>28</sup> and likely increases the chance that the workstation is well-designed to support work. Those who do not have a dedicated space are therefore more likely to be spending extended periods of time at workstation without appropriate adjustments, increasing the odds of bodily pain and other physical health conditions.<sup>20</sup> In particular, home workers mainly reported to be less productive, with lower job satisfaction and increased neck pain.<sup>32</sup> Unfortunately, a previous survey found that more than half of the respondents reported not paying attention to ergonomics while WFH.<sup>13</sup> In addition to the workstation itself, WFH allows workers to adjust the lighting, temperature and ventilation according to their personal preferences. Previous research has found that good IEQ at a workspace helps to improve workers' comfort and reduce distractions to achieve higher productivity at work,<sup>7</sup> which in turn can affect health and well-being of occupants.<sup>8</sup>

While our study provides insight into numerous important factors to be considered in supporting the physical and mental well-being of workers who are WFH, multiple limitations should be acknowledged in the interpretation and use of these findings. First, it

is important to note that these data were obtained within the early days of the COVID-19 pandemic; therefore, the findings are not meant to directly represent traditional WFH circumstances and may not represent the health status or experiences once the restrictions and WFH became increasingly routine. Secondly, our sample included over-representation from workers in California, who were Caucasian, and who had higher levels of education and annual income than the average worker in the U.S. While the implications of the data are valid, application of the findings may not be widely generalizable across different regions or countries and may differ from the experiences of individuals with different backgrounds. Finally, while the respondents represented a wide range of occupational categories, these categories are not representative of all job categories, nor do these data completely represent at all jobs that are included within each category.

## CONCLUSIONS

Due to the COVID-19 pandemic, many workers were abruptly asked to WFH due to stay-at-home mandates to meet social distancing requirements. These workers reported a decline in overall physical and mental health status and an increased number of new physical and mental health issues. Significant predictors of decreased physical and mental health status included decreased physical activity, increased junk food intake, lack of communication with coworkers, and having a toddler at home. Additionally, having more distractions was a significant predictor of decreased mental well-being. Around two-thirds of respondents reported having one or more new physical health issues, and nearly three-fourths of respondents experienced at least one new mental health issue. Female respondents and respondents with annual income of less than 100k reported health issues compared to male respondents and respondents with higher incomes. Respondents reported increased physical and mental health issues with less physical exercise, more junk food intake, having at least one infant at home, being distracted while WFH, decreased communication with coworkers, higher workload, increased work hours and adjusting work hours around others. Respondents who lived with at least one teenager, had higher satisfaction over IEQ factors at home, had a designated workspace, and had a good workstation set up, all had lower chance of experiencing new physical and mental health issues. This study highlights factors that impact workers' physical and mental health well-being while WFH and provides a foundation for considering how to best support a positive WFH experience.

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