

# The virtual office: A perspective from college students

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## Abstract.

**BACKGROUND:** As the COVID-19 pandemic took root in the United States, most universities quickly transitioned to online and remained there through spring 2021.

**OBJECTIVE:** The study objective was to identify the impact of the switch to online on student home offices and corresponding health outcomes.

**METHODS:** An online survey was sent out to all student at a large Midwest university to assess the work practices and health outcomes.

**RESULTS:** In total, 1074 responses were completed. The shift to online not only resulted in most students utilizing laptop computers without external monitors, keyboards, or mouse input devices, but also a major increase in the amount of time spent using technology (on average 31 to 40 hours per week). The amount of severe to extreme discomfort in the neck, shoulder, upper back, and lower back was alarming (above 41%).

**CONCLUSION:** The home offices of students were often sub-optimal, indicating the need to educate university students.

Keywords: Telework, musculoskeletal disorders, human-computer interface, musculoskeletal discomfort, keyboard, laptops, breaks

## 1. Introduction

There are 16.6 million undergraduate and 3 million graduate students in universities within the United States [1]. The majority of these students shifted to online learning due to the COVID-19 pandemic in the spring of 2020 (March) and continued through the spring semester, 2021 (May). With this shift to virtual classes, there are many potential concerns that could plague students at home.

Students have been found to suffer from relatively high levels of discomfort (29%–72%, 17%–62%, and 21%–70% for low back, upper back, and neck, respectively) [2–8]. Jacobs and colleagues [9] investigated the usage of laptops for undergraduates in a university dormitory where they found individuals who utilized an external keyboard and mouse had significantly lower discomfort than those who were solely laptop users. Laptop usage in the student population has been found to be relatively high (66%–94%) [9–11]. Long periods of usage of computers by students have been found to increase musculoskeletal discomfort, especially without breaks [12].

Laptop usage oftentimes results in high prevalence of neck and low back pain (above 50%) [2, 13].

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The use of laptop computers for long durations is particularly worrisome since using them results in severe neck flexion (exceeds 20° flexion) and awkward back postures [14]. Other researchers have identified various postural strains for students at home including: lack of back support, arms are not extended (along their sides) while using computer, non-adjustable monitor, keyboard, or chairs, and contact with the sharp edge on front of the desk [15]. Bubric and Hedge [2] documented the non-ergonomic conditions that college students use while working on laptops, such as: 1) sitting in various positions on the bed with laptop on bed or lap, 2) sitting on the couch with computer on lap, 3) laying on the floor with laptop in front on floor, and 4) working on a flat desk surface with sharp edges. The use of a laptop while seated on a couch caused awkward wrist postures while typing on the keyboard or activating the touchpad, the arms to be unsupported which placed stress on the upper back, and the neck to be flexed while looking down at the screen [16]. However, Jacobs and colleagues [9] found that using external input devices with their laptops, such as a keyboard and mouse, resulted in less computer-related discomfort than using laptop devices on their laps [9]. Once we understand how students are working online at home, we can potentially develop interventions to help them. Moslander and colleagues [17] showed that students who participated in a participatory ergonomic program did not effectively result in changes in the student workstations. Thus, it will not just be about identifying issues for students.

The current study conducted a survey of undergraduate and graduate students at a large Midwest university to determine the working conditions that they are operating under during online education due to COVID-19.

## 2. Methods

### 2.1. Study design

An online survey was sent out to the entire graduate and undergraduate student body at the University of Cincinnati in February 2021. Several email reminders were also sent out. The survey evaluated the impact of online courses on the discomfort, stress, and fatigue experienced by students.

### 2.2. Study population

A total of 1074 students completed the online survey, where 787 were undergraduates, 155 Master's,

Table 1  
Breakdown of the enrollment type, type of student, and college

	Number
Enrollment type of student	
Full time	903
Part time	171
Type of student	
Undergraduate	787
Master's	155
Doctorate	106
Other	26
College	
College of Allied Health Sciences	93
College of Arts and Sciences	251
College Conservatory of Music	27
College of Engineering and Applied Sciences	183
College of Education, Criminal Justice, and Human Service	87
College of Business	111
College of Law	23
College of Medicine	55
College of Nursing	65
College of Pharmacy	6
College of Design, Architecture, Art and Planning	79
UC Blue Ash College	67
UC Clermont College	27

106 Doctoral, and 26 students who fell into an "other category" (e.g. non-matriculated). The majority of the completions were from full-time students (84%). The students were located across the university with the largest completes being in the College of Arts and Sciences, College of Engineering and Applied Sciences, and College of Business. The complete breakdown is in Table 1.

### 2.3. Home office survey

The survey contained many of the items within the survey developed by Gerding and colleagues [18], which was developed in REDCap (Research Electronic Data Capture, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA). Table 2 provides a summary of the items inquired within the survey.

### 2.4. Data analyses

Descriptive statistics were determined for each variable, including frequency and percentage of samples responded.

## 3. Results

Before COVID-19, more than 92% of the students reported never being online for courses while the

Table 2  
Components of the survey administered to the students at the University of Cincinnati

Variable	Responses
<b>Demographics</b>	
Enrollment type	Full, Part
Student type	Undergraduate, Masters, Doctorate, Other
College	College of Allied Health Sciences, College of Arts and Sciences, College Conservatory of Music, College of Engineering and Applied Sciences, College of Education, Criminal Justice, and Human Service, College of Business, College of Law, College of Medicine, College of Nursing, College of Pharmacy, College of Design, Architecture, Art and Planning, UC Blue Ash College, UC Clermont College
<b>Prior to COVID-19</b>	
<b>During COVID-19</b>	
Number of hours using technology	0–10 hours, 11–20 hours, 21–30 hours, 31–40 hours, 41–50 hours, 51–60 hours, more than 60 hours
<b>Percent time prior to COVID-19</b>	
<b>Percent time during COVID-19</b>	
Laptop, Tablet, Desktop, Smartphone, Other	0–20%, 21–40%, 41–60%, 61–80%, 81–100%
<b>Ergonomic posture and device usage</b>	
Back sideways, Back forward, Back twist, Back against chair, Feet flat on floor, Thighs parallel to floor, Knees bent 90 deg, Arms reaching out, Sharp edge on desk, Wrist deviated, Wrist flexed, Arms on armrests	Never, A little of the time, Some of the time, Most of the time, All of the time
Built in mouse, Built in keyboard, Built in touchpad, External mouse, External keyboard, External touchpad, Mouse and keyboard at same level	
<b>Usage of chairs</b>	Chair with adjustable armrests, Chair with no adjustable armrests, Bed, Couch, Other
<b>Usage of monitors</b>	1, 2, 3, 4
<b>Length of time without break</b>	30 minutes or less, 31 to 60 minutes, 61 to 90 minutes, 91 to 120 minutes, More than 120 minutes
<b>As compared to prior to COVID-19</b>	
Discomfort, Stress, Fatigue, Ability to concentrate	A lot less, A little less, Same, A little more, A lot more
<b>Discomfort</b>	
Head/neck/eyes, Upper back/shoulders, Lower back	None (0), Mild (1–2), Moderate (3), Severe (4–5)

complete opposite occurred during COVID-19 (92% were online). The switch to online learning increased the reliance on technology, where the students used technology about 11 to 20 hours per week on average prior, increasing to 31 to 40 hours per week on average during the pandemic (Fig. 1). Students also utilized laptops more often during the pandemic than prior (about 25% more), but this resulted from less use of desktops (Fig. 2). The use of input devices was usually for long periods, where 80% worked longer than 60 minutes before a break, with 51% working more than 90 minutes continuously. Most students used an internal keyboard (79% most of the time or more) of the laptop (See Fig. 3) with internal touchpad and mouse being used next most (56% and 37%, respectively).

Students did not set up their work areas to ensure that they were in non-neutral postures. First, back postures were reported (some of the time or more) to be flexed forward 88% of the time, bent sides way 57% of the time, and twisted 35% of the time. Second,

less than 25% of the students reported that their back was against the back of the chair most or all of the time. Furthermore, students worked in workstations that did not have their back against the back of the chair (39% never or seldom), feet flat on the floor (50% never or seldom), and knees at 90° (39% never or seldom). Other ergonomic concerns were the high percentage of arms reaching out (60% most of the time or more), arms resting hard sharp edge (33% most of the time or more), wrist flexed or deviated (25% most of the time or more), and arms not on armrests (72% never or seldom). Also, most students used one monitor (68%), potentially indicating they used laptop monitors only (70% used their laptop all the time). Finally, only 40% of the students used an office chair with armrest, with 40% using an office chair without armrests, and 17% sitting in a couch or bed.

The impact of these online classes seemed to have a negative impact on the students. Students felt discomfort more often when compared to pre-pandemic

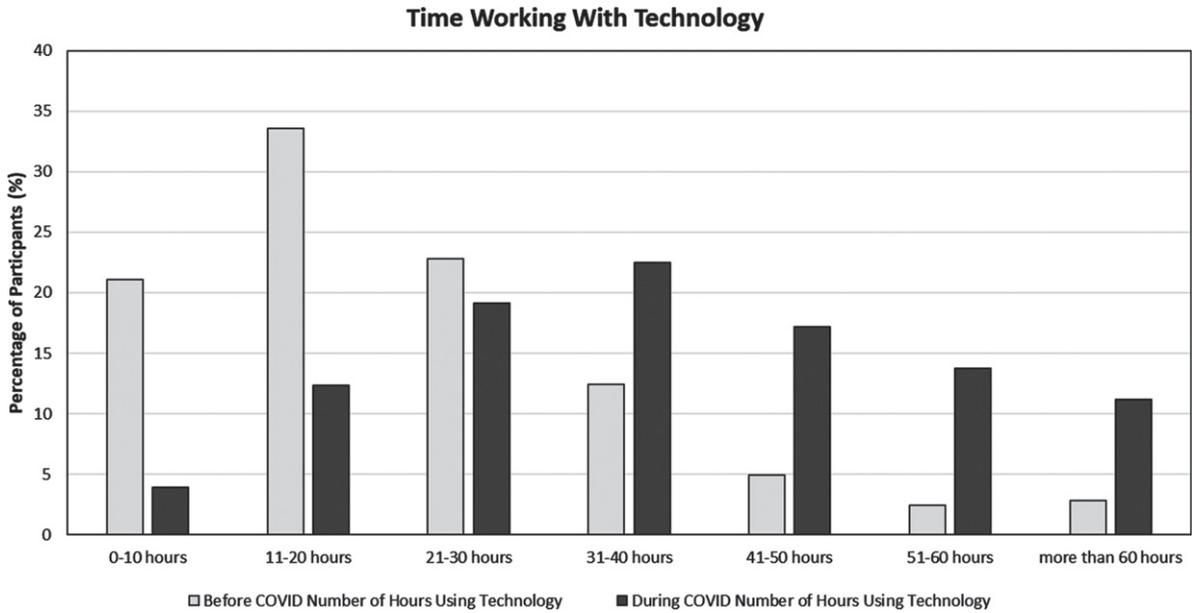


Fig. 1. Usage of technology reported by students prior and during COVID-19.

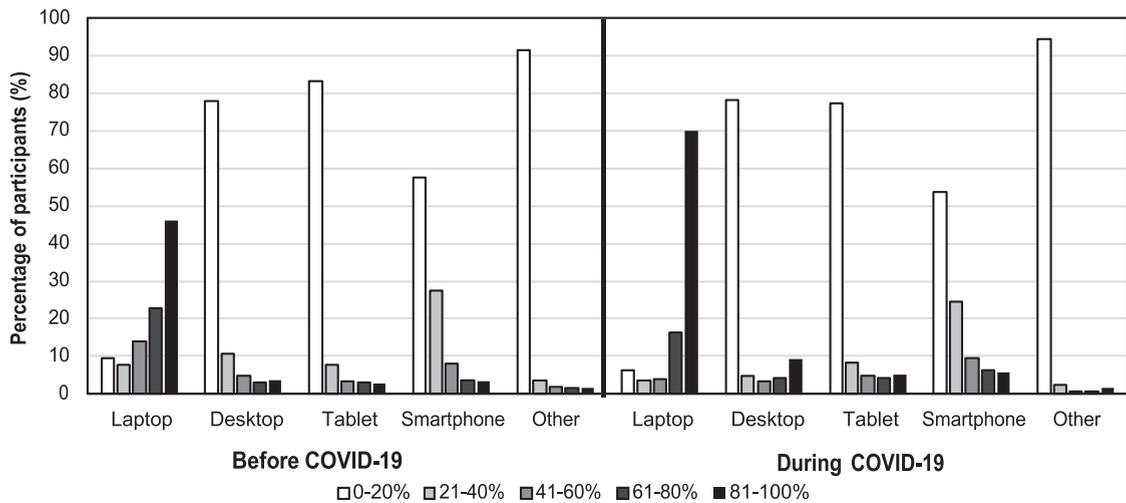


Fig. 2. Usage of laptops, desktops, tablets, smartphones, and other for computer use.

times (63% said a little or a lot more). Stress and fatigue were also found to be more prevalent during COVID-19 than prior (69% for stress, 65% for fatigue saying a little or a lot more). Ability to concentrate was significantly lower during COVID-19, with 57% saying it was more difficult to concentrate (a little or a lot). See Fig. 4 for complete results for overall discomfort, stress, fatigue, and concentration during COVID-19 as compared to prior to the pandemic.

Students were suffering from high levels of discomfort in multiple body regions both in intensity

and prevalence. First, 92% of the students reported discomfort in the eye, neck, and head region, with more than 63% reporting the discomfort to be severe to extreme. Several body regions had more than 60% of students reporting some level of discomfort (lower back: 84%, shoulder: 78%, upper back: 76%, middle back: 70%, lower arms, wrist, and hands: 61%) (see Fig. 5). Several of these regions (shoulders, upper back, and lower back) had above 40% of students reporting severe to extreme discomfort.

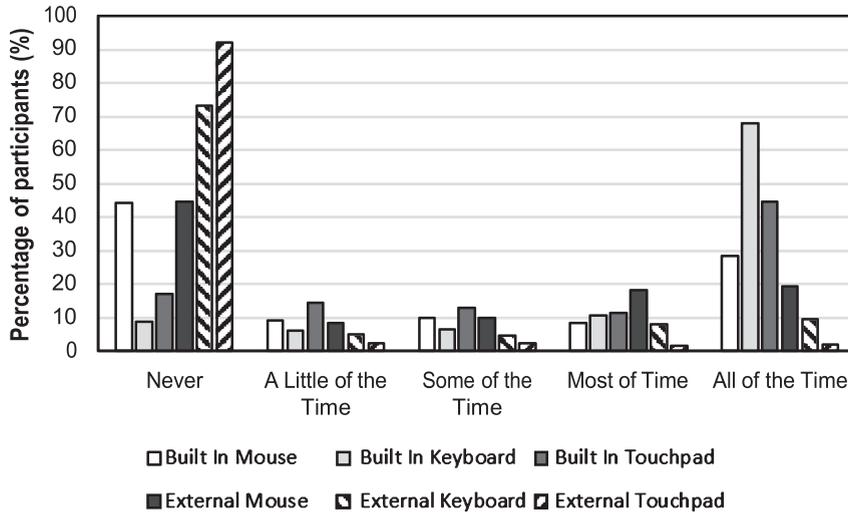


Fig. 3. Usage of input devices.

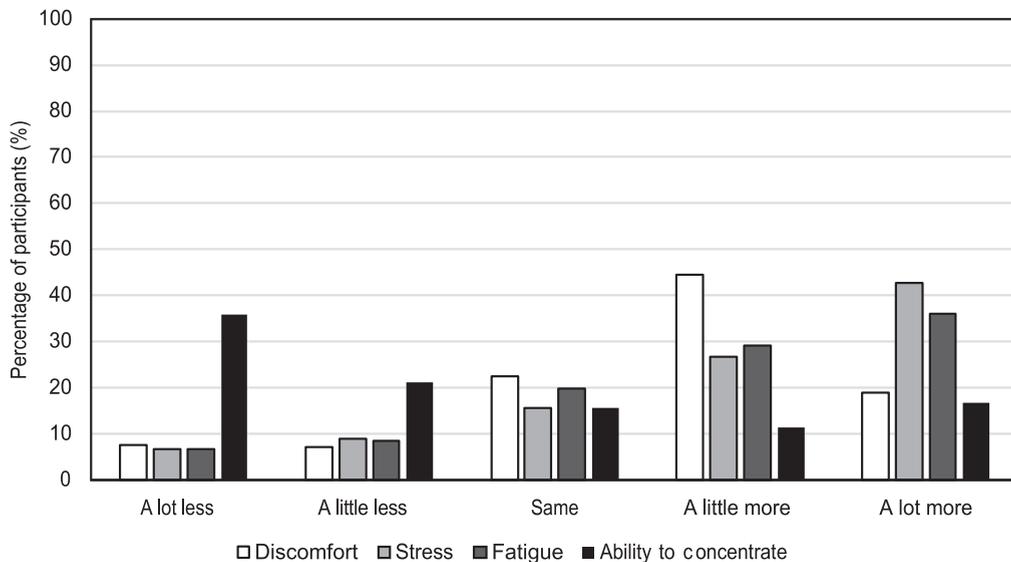


Fig. 4. The impact of online courses due to COVID-19 on discomfort, stress, fatigue, and ability to concentrate.

#### 4. Discussion

The switch to online courses had a tremendous impact on how students were taught when the COVID-19 pandemic hit. There was a total shift from never online (92%) to completely online (92%). The survey was completed by a robust number of students including 903 (84%) full-time, 787 (73%) undergraduate students, and 261 (24%) graduate students (Master and doctorate), and distributed within all the colleges across the university. In total, 1074 students completed the survey.

It was not surprising that there was a tremendous shift to being online; however, the surprise was the number of hours spent using technology (averaged about 11–20 hours per week pre-pandemic vs. 31–40 hours per week during pandemic). This represents a large increase in actual time working on the laptop, that would likely cause concerns ergonomically. The majority of the students reported that they predominantly worked on a laptop (about 70%) without using an external monitor (68%), keyboard (73%) or mouse (44%). Jacobs and colleagues [9] documented lower discomfort when using an external keyboard

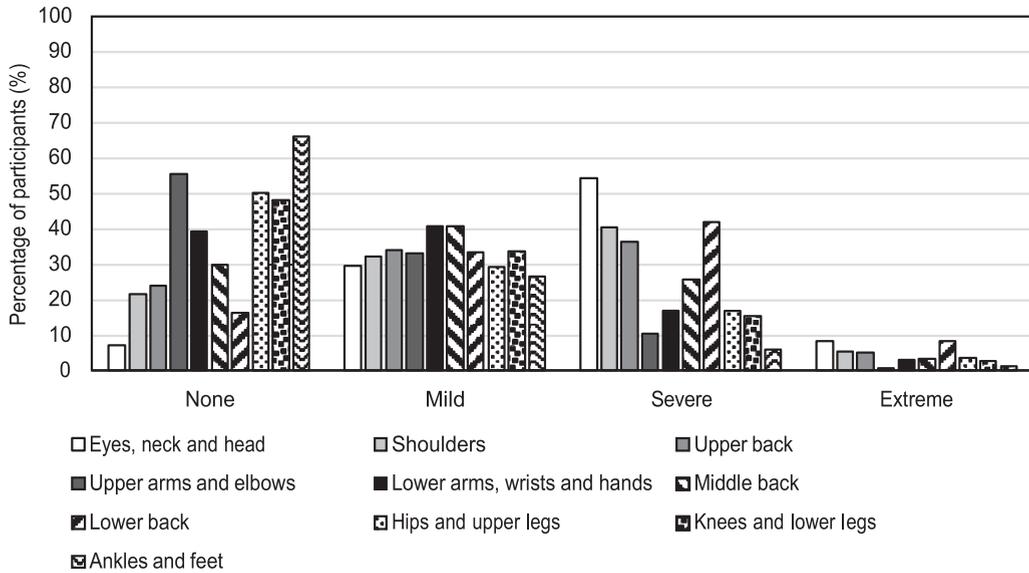


Fig. 5. Current body discomfort for university students.

and mouse, indicating that these results may yield high levels of discomfort. Laptop usage appeared to be in line with previously investigated student usage of 66%–94% [9–11]. Results also completely support findings of Tullar and colleagues [15] who found many poor ergonomic conditions such as limited long periods of laptop usage, lack of back support, contact with hard surface edges, and lack of adjustability.

Another alarming aspect of the student work environment is the high levels of working while seated on the bed or couch (around 17%). Bubric and Hedge [2] have identified major ergonomic concerns when working from the bed or couch. Using laptops in bed and on a couch will likely result in severe neck flexion and awkward low back postures, resulting in discomfort when adopted for long durations [14].

The large portion of the student population reported higher levels of discomfort (63%), fatigue (69%), stress (65%), and lack of ability to concentrate (57%) compared to prior to COVID-19 and being sent home for online courses. Basically, the majority of the student body appears to be in distress due to online courses. There were also alarming levels of discomfort in the neck and head (63% severe to extreme), shoulders (45% severe to extreme), upper back (42% severe to extreme), and low back (50% severe to extreme). These regions have been previously identified as common areas of discomfort in students [2–8], but the current study seems to have identified more severe levels of discomfort (as pre-

vious research documented mostly prevalence of any discomfort).

Many of the results of the current study investigating students resembles similar trends seen for office workers, specifically faculty and staff that have been sent home to work in their home office due to COVID-19. Our research group identified virtual workers predominantly relied on laptops without an external monitor, keyboard, and mouse [18–20]. It is also interesting that similar percentages of people utilized beds or couches when working at home.

Based on this study and other studies [18–20] investigating the ergonomic condition when working from home, there are several common interventions for work from home that can be easily implemented. First, use an adjustable chair with arm rests. If the chair does not have a built in adjustable lumbar support a small pillow or rolled up towel can be substituted. If the arm rests are not adjustable and are too low, they can be wrapped in towel to help increase their height. Second, when using a laptop, place it on an elevated surface which can be created using a box or stack of books so the screen is at the appropriate height, then use an external keyboard and mouse. If an external monitor is available it should be utilized after positioning it correctly. Third, if the desk or work area has hard front edge, use a rolled towel, a piece of pipe insulation, or a pool noodle to provide a softer landing area for wrists. Fourth, create a standing workstation if possible so one can alternate between sitting and standing. This can be a kitchen

counter or stacked boxes or crates with an additional platform on top of the normal sitting work surface. Lastly, take a short (1–2 minute) break approximately every 30 minutes. The key is to adjust the work area to your body and take routine breaks.

## 5. Limitations

There are a few considerations that need to be kept in mind when interpreting these results. First, while the number of participants were large ( $n = 1074$ ), it represents a small portion of the roughly 47,000 students that attend the University of Cincinnati. In March, 2020, the university went entirely online with the majority of the classes remaining online at the time of the survey (February 2021). The sample population was a representative sample across the university. Second, as with all surveys, the responses rely on the subjective perception of the participants and thus have the potential for negative affect that leads to increased ratings of negative health outcomes like discomfort. It is likely that the survey results do offer a glimpse into the current status of the students' environment and health conditions. Third, part of the survey was retrospective, which means it relies on the memory of the students about what was going on prior to COVID-19 pandemic. There is a need for a more extensive study assessing the postures and physical demands that the students incur at home, thus the current study represents a preliminary glimpse into work from home for students.

## 6. Conclusion

University students were impacted suddenly by the COVID-19 pandemic when the majority of universities switched to online courses, resulting not only in a shift to laptops, but also a major increase in the amount of time spent using technology (on average 31 to 40 hours per week).

Many students worked from very poor work environments such as using a laptop in bed or on the couch, oftentimes without external monitor, keyboard, or mouse. The amount of severe to extreme discomfort in the neck, shoulder, upper back, and lower back was alarming (above 41%). Stress, fatigue, and an inability to concentrate were found to be greater in more than half of the students than prior to COVID-19 and the shift to online classes. Students were found to work at home in sub-optimal

conditions, indicating a need to educate our university students about proper ergonomics.

## Conflict of interest

The authors have no potential conflicts of interest to disclose.

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