

# Effects of COVID-19 on Engineering Students' Baseline Stress

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## CONTEXT

With the onset of the COVID-19 pandemic, and the resulting response from universities, engineering students find themselves in an unprecedented situation. In addition to stressors related to the curriculum, residential students across the United States are being asked to relocate away from campus and engage in distance learning. At the same time, social distancing requirements are limiting students' ability to socialize, procure food and supplies, exercise, and remain employed and financially solvent. Some students will fall ill while others face the prospect of sick family members, and even deaths in the family. Prior research suggests that individuals living through this pandemic are likely to face stress, uncertainty, and fear that affects their mental health and academic performance for years to come.

## PURPOSE OR GOAL

The purpose of this study was to understand the ways in which the COVID-19 pandemic is affecting engineering students' mental wellness, specifically stress, and how the effects differ for different groups of students. The research questions addressed are: 1) What effects has the pandemic had on baseline stress levels, and how do those vary by demographic group? 2) What effects has the pandemic had on quality of life, such as sleep habits and financial security, and how do those vary by demographic group?

## METHODS

An online survey was conducted in the United States in May and June of 2020. More than 800 4-year engineering students who represented many engineering disciplines and universities responded. The survey used a modified version of the Holmes-Rahe Social Readjustment Rating Scale, which is a widely used and validated instrument to measure the effects of certain life events on stress. The data was analysed to determine the average increase in stress levels for students resulting from COVID-19, and which demographic groups have seen the most negative impact. We also report on which stress-inducing life-events were experienced most.

## OUTCOMES

Latinx individuals and international students report statistically significantly higher levels of stress than the baseline population. Engineering students from other historically excluded identities, however, are not facing statistically significantly worse stress than their peers from historically overrepresented identities. Veterans fare better than the majority population on this metric. The data also indicates that different groups are more likely to experience different negative life-events because of COVID.

## CONCLUSIONS

No previous research has examined the impacts of a global pandemic on engineering student stress and mental wellness. Our findings show that stress and mental wellness need to be understood intersectionally and that some underrepresented groups are disproportionately impacted by COVID-19. Understanding the impacts on students can help universities strategize and allocate limited resources most effectively to support student success.

## KEYWORDS

Mental wellness; COVID-19; stress

## Introduction

With the onset of the COVID-19 pandemic, and the resulting response from colleges and universities around the globe, engineering students are finding themselves in an unprecedented situation. In addition to stressors related to the engineering curriculum (Jensen & Cross, 2018), many residential college students were asked to relocate away from campus, and engage in what, for many students and professors, was a new learning modality: distance learning. At the same time, shelter in place and social distancing requirements changed and, (in some countries) continue to impact a number of non-academic factors for students, including ability to socialize, ability to engage in romantic relationships, ability to procure food and supplies, ability to exercise and engage in athletics, and ability for students or their providers to remain employed and financially solvent. Finally, as COVID-19 lingers, some students have fallen ill, while others faced the prospect of sick family members and deaths in the family.

This paper catalogs the incidence of negative life events and disruptions caused by the pandemic on engineering students. The hope is that engineering educators, program administrators, and policy makers can use this data to determine how to best support their diverse student populations both in the immediate future, and during future pandemics, which are expected to occur with increasing frequency (Smith et al., 2014). While our data is limited to four-year engineering programs in the United States, and while the United States has some unique issues with virus containment and health inequality, we believe that this data is nonetheless instructive for a broader audience.

## Background

Existing research suggests that university students suffer from mental health and wellness issues at rates higher than those found in the general populace (Flatt, 2013; Goodwin, 2008; Wynaden et al., 2013). Due at least in part to the stress of the curriculum (Jensen & Cross, 2019), engineering students are particularly susceptible to mental health concerns (Danowitz & Beddoes, 2020a, 2018; Soares Passos et al., 2020). These results have been shown to hold for Australian university students as well (Loosemore et al., 2020; Wynaden et al., 2013). To ensure the success of engineering students, it is therefore important for universities and colleges to understand how the current COVID-19 crisis may have changed the mental health of their students.

There is limited research documenting the effects of a global pandemic on mental health for either the general populace, university students, or engineering students. Studies conducted in Australia, however, have shown that regional pandemics and other natural disasters have negative impacts on the populace's mental health and stress levels (Morrissey & Reser, 2007; Taylor et al., 2008). Additionally, studies not specific to Australia predict that a global pandemic would likely have a severely negative impact on populace mental wellness (Douglas et al., 2009; Perrin et al., 2009). These studies base their conclusions, in part, on the negative mental health consequences that have been observed in populations during localized pandemics (Taylor et al., 2008). Research in the aftermath of previous localized pandemics has confirmed that students are not immune to these mental health consequences (Xu et al., 2011), suggesting that the COVID pandemic will have a negative impact on student mental health. The effects of COVID-19 on engineering student mental health may be further exacerbated by the negative effects that the pandemic is having on the economy. Past economic recessions have been shown to decrease mental health of the overall populace (Frasquilho et al., 2016), and university students in particular (Berg-Cross & Green, 2009; Hammarström & Virtanen, 2019).

Taken together, COVID-19 as a major pandemic and economic recession event is likely to have significant impacts on stress and mental health of engineering students. Additionally, experts have noted that the frequency of new pandemics has increased in recent years (Chin et al., 2020; Lindahl & Grace, 2015), and some predict that as the human population continues

to expand and push into areas that were formerly wilderness, pandemics will become more frequent in the future (Daszak et al., 2020; Smith et al., 2014). To prepare universities, programs, and departments to meet their students' needs now and during future pandemics, we examine the ways in which COVID-19 has contributed to students' stress-load and characterize the disparate effects of COVID-19 on the stress levels of different demographic groups within engineering.

## Methods

### Data Collection

The data presented here was collected as part of a larger survey instrument designed to capture multiple facets of engineering student mental health and wellness during COVID. This paper focuses on data related to student stress levels. The effects of COVID on student stress was assessed using a modified version of the Social Readjustment Rating Scale (SRRS) (Holmes & Rahe, 1967). This instrument asks participants to read through a list of stressful life-events (e.g. death of a family member, personal illness, etc.) and report which if any of these events had happened to them within the prior six months. Each life event on the survey has a corresponding numerical stress score. At the conclusion of the survey, the survey administrator sums up the score values for the stressful life events the participant reported and computes a final stress score. While the creators intended to use this stress score to predict future illness on the part of the participant, we use the score only as a relative measurement of COVID-19 induced stress in engineering students. Since the SRRS was designed to track stressful life events that might befall an average adult, we altered and omitted some of the original life events to better tailor the instrument to our target student population. For the modified life events, the original stress scores were kept. Our version of the SRRS is shown in Table 1.

**Table 1. Questions and "Stress Scores" for modified SRRS**

Life Event	Score	Life Event	Score	Life Event	Score
Death of spouse or serious partner	100	Major change in financial state	38	Changing to a new school	20
Ending a romantic relationship	73	Death of a close friend	37	Major change in type/amount of recreation	19
Mandatory quarantine	63	Major change in number of arguments with romantic partner	35	Major change in church activity	19
Death of a close family member	63	Foreclosure on mortgage or loan	30	Major change in social activities	18
Major personal injury or illness	53	Major Change in work/school responsibilities	29	Taking on a loan	17
Losing job or internship offer	47	Ceasing formal schooling	26	Major change in sleep habits	16
Major change in health or behavior of a family member	44	Major change in living conditions	25	Major change in number of family get-togethers	15
Sexual difficulties/ major changes in sexual activities	39	Major change in work/school hours or conditions	20	Major change in eating habits	15
Living with new people	39				

In addition to stress data, the survey collected a wide swath of demographic information from respondents, including school attended, gender, sexuality, race/ethnicity, veteran status, and whether they have been diagnosed with a mental health issue.

With Institutional Review Board (ethics) approval, the survey was distributed in the United States from May through July 2020. We pursued several avenues of survey distribution to ensure that the survey reached a broad, representative population of U.S. engineering students. These efforts included but are not limited to emailing the engineering deans of the California State University System, distributing the survey link and sample recruitment material through American Society of Engineering Education (ASEE) national and regional mailing lists, engaging national engineering societies, including The Society of Women Engineers (SWE),

to advertise the survey to their members, and leveraging our own personal connections to get the survey distributed.

## Participants and Data Analysis

The survey gathered roughly 1300 raw responses, of which roughly 670 were determined to belong to students currently enrolled in engineering baccalaureate programs at a U.S. based non-profit college or university and completed enough of the survey for analysis. The other survey responses are largely attributable to responses from 2-year engineering students, students enrolled in “pre-engineering” programs, students at for-profit universities, some students attending college abroad, and several untrustworthy responses. Respondents identify as 57% white, 13% Asian, 16% Latinx, 7% African American, and 4% Native American; 61% male vs 39% female; 91% identify as heterosexual, 4% bisexual; 6% identify as international students; and 24% identify as veterans.

Data analysis was conducted using the R open-source statistics language (R Core Team, 2020) using the RStudio environment (RStudio Team, 2019).

For each of the life events in our modified SRRS, we conducted a logistic regression to estimate which demographic factors are statistically significant predictors ( $p < 0.05$ ) of which life event. In other words, which populations of students are more likely to experience job loss, eating changes, etc. The baseline populations are “white” for race, “heterosexual” for sexuality, “male” for gender, “not international” for international student status, and “not a veteran” for veteran status. For the SRRS events not listed, no measured population was statistically more or less likely than the baseline population to report the life event.

## Survey Results

Figure 1 shows a histogram of responses to the modified SRRS instrument.

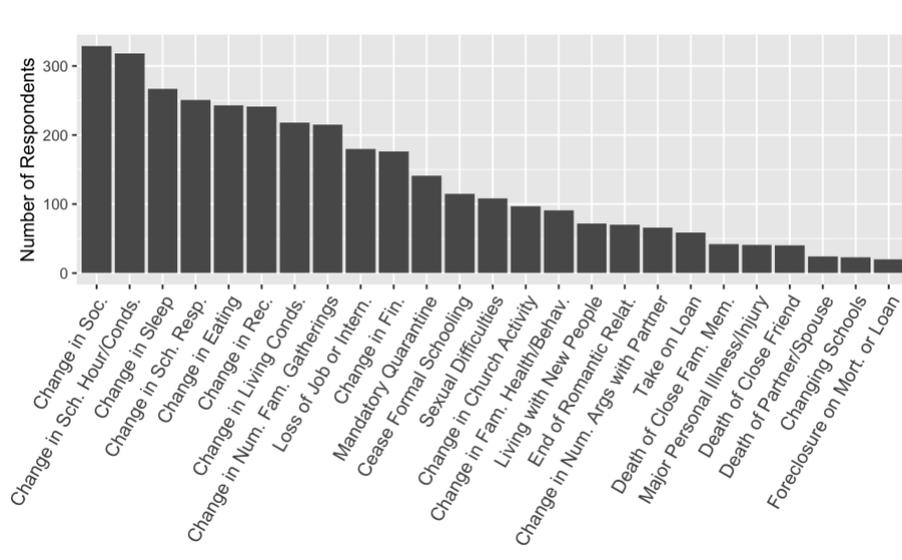


Figure 1. Histogram of modified SRRS items faced by students because of COVID-19

As shown in Table 2, as of May–June, veterans and international students are most likely to experience loss of a friend or loved one due to COVID-19 compared to any other group. The frequency of Latinx in the “More likely than baseline population” column indicates that Latinx individuals are at higher risk for several COVID-related stressful life events than their white non-Hispanic peers.

The numerical stress scores from Table 1 allow for a direct comparison of net COVID-induced stress between different groups. Using the same baseline populations used for the analysis in Table 2 (white, heterosexual, male, non-international student, non-veteran), we ran a linear regression to determine the nature of the relationship between demographic and total numerical stress scores. The result of the model showed that Latinx respondents were the only group to have a stress score that was statistically significantly higher ( $p = 0.002$ ) than the baseline population. Veteran respondents had lower COVID-related stress scores ( $p = 0.00000017$ ) than the baseline (non-veteran) population. Relaxing significance requirements, International students also showed above baseline stress scores ( $p = 0.06$ ), while Native Americans showed below baseline stress scores ( $p = 0.07$ ).

**Table 2. Populations significantly ( $p < 0.05$ ) more or less likely to be affected by a life event**

SRRS Event	More likely than baseline pop.	Less Likely than baseline pop.
Ending serious relationship	International	Asian, Veteran
Mandatory Quarantine	Asian	
Death of a close family member	Veteran	
Major personal injury or illness		Veteran
Losing job or internship	Bisexual	Native American, Veteran
Major change in health or behaviour of family member	African American	Asian
Major change in finances	Latinx	Native American
Death of close friend	International	
Major change in work or school responsibilities	Latinx, Bisexual	International
Ceasing formal schooling		Women
Major change in living conditions	Latinx	Veteran
Major change in work/school hours or conditions	Latinx, Bisexual	Women, Veteran
Changing schools	International	
Major change in type/amount of recreation	Latinx	Veteran
Major change in social activity	Asian, Latinx, Bisexual	Women, African American, International, Veteran
Major change in sleep habits	Latinx, Bisexual	Native American
Major change in number of family get-togethers	Latinx	Native American, Veteran
Major change in eating habits	Asian, Latinx	Veteran

## Discussion and Conclusions

In regard to Figure 1, some of the most common responses, such as changes in social life, were somewhat expected given the large number of campus closures during the U.S. spring semester (and the onset of summer vacation while the survey was active). The prevalence of incidences like loss of work and change in financial situation, loss of relationship or more arguments with a spouse or significant other, and ceasing schooling, however, are potentially more worrisome among this demographic as they may point directly towards long-lasting deterioration in living conditions and opportunity.

Our sample of students shows that, overall, only Latinx individuals and international students report statistically significantly higher levels of stress than the baseline population. While this is certainly worrisome and points to the need for additional resources and interventions targeting these communities, from a COVID-induced-life-event perspective, engineering students from other historically excluded identities (women, Asian Americans, African Americans, Bisexual individuals) are not faring significantly worse than their peers from historically overrepresented identities. Some, like Native Americans and Veterans fare better

than the majority population on this metric, although this may be an artifact to the small number of Native American respondents.

The life events shown in Table 2 highlight that there are clear differences in the types of life events affecting each group. Male engineering students, for example, are more likely than female students to cease schooling as a direct result of COVID, potentially indicating the need for a target intervention for that group. Additionally, while veterans appear to be facing less COVID-life-event-related stress than their peers, the high-baseline of mental health issues for U.S. student veterans (Rudd et al., 2011), coupled with the increased likelihood of veterans reporting the death of a close family member related to COVID-19 may demonstrate an urgent need to offer and advertise bereavement and other counselling services to this population.

Indeed, in analysing these results, it is important to consider that any COVID-related stress is likely in addition to the high-levels of mental health and wellness issues already faced by engineering students. Therefore, it is possible that even an “average” increase in stress levels caused by COVID-19 may drive students from certain historically excluded groups to excessive levels of distress. Our findings show that stress and mental wellness need to be understood intersectionally and that some underrepresented groups are disproportionately impacted by COVID-19. Understanding the impacts on students can help university administrators and student support staff allocate limited resources most effectively to support student success.

These findings are the first phase of our analysis. In the next phase, we will utilize these findings on stress to more directly determine its impact on mental wellness by analyzing the stress data in relationship to other data from the survey, including anxiety, depression, post-traumatic stress disorder, and non-specific psychological distress. Additionally, we will compare these COVID-19 findings to data collected prior to the pandemic (Andrew Danowitz & Kacey Beddoes, 2020) to better understand the pandemic’s impact on student mental wellness. We also collected data on what students wish their universities had done differently and strategies they used to cope with mental health challenges during the pandemic.

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