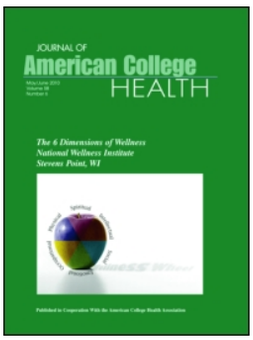

Journal of American College Health

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/vach20

Survey of COVID-19 isolation cases at a major university campus in the United States

Mark Brickhouse, Jeffrey Gassen, Benjamin J. Ryan & Michael P. Muehlenbein

To cite this article: Mark Brickhouse, Jeffrey Gassen, Benjamin J. Ryan & Michael P. Muehlenbein (2023): Survey of COVID-19 isolation cases at a major university campus in the United States, Journal of American College Health, DOI: 10.1080/07448481.2022.2155062

To link to this article: https://doi.org/10.1080/07448481.2022.2155062

JOURNAL OF AMERICAN COLLEGE HEALTH
https://doi.org/10.1080/07448481.2022.2155062

Routledge
Taylor & Francis Group

MAJOR ARTICLE

Survey of COVID-19 isolation cases at a major university campus in the United States

Mark Brickhouse, PhD[a], Jeffrey Gassen, PhD[b], Benjamin J. Ryan, PhD, MPH[c] and Michael P. Muehlenbein, PhD, MSPH[b]

[a]Baylor Health Services, Baylor University, Waco, Texas, USA; [b]Department of Anthropology, Baylor University, Waco, Texas, USA; [c]Department of Environmental Science, Baylor University, Waco, Texas, USA

ABSTRACT

Objective: Baylor University established a surveillance system to assess the needs of students and faculty in isolation from SARS-CoV-2 as well as any longer-term symptoms. **Participants:** Overall, there were 309 responses between March 20 and May 19, 2021. **Methods:** A survey covering experience in isolation, symptoms, vaccination, and demographic characteristics was emailed to individuals on Day 7 of isolation; a follow-up health survey was sent 30 days later. **Results:** Only 9.6% of respondents reported needing assistance while in isolation. Nearly 75% of respondents experienced COVID-19 symptoms in isolation, and 31.9% had remaining symptoms after isolation. Older age, being male, and more severe symptoms were associated with longer symptom duration. Those vaccinated had lower odds of developing symptoms and having symptoms remaining post-isolation. **Conclusions:** The present study adds to our understanding of long-COVID in young adult populations, while providing a framework for similar institutions to sustain operations during a global pandemic.

ARTICLE HISTORY
Received 19 March 2022
Revised 13 July 2022
Accepted 19 September 2022

KEYWORDS
Higher education; Qualtrics; symptoms; vaccination

Introduction

The SARS-CoV-2 virus has been challenging for institutions of higher education to manage and control. This is due to both the biology and epidemiology of the virus, as well as behaviors of college students. The virus can be spread by symptomatic and asymptomatic individuals, and college students (especially first year) often experience among the highest rates of infection compared to other groups due to communal residences, shared dinning, and social gatherings.[1] The SARS-CoV-2 virus also has a short latency period and spreads via small droplets and aerosols, especially through splashes and sprays from a cough or sneeze, and when a person touches their eyes, nose, or mouth with hands contaminated with the virus.[2] These traits enable rapid spread among large groups of socially interacting people such as college students who are often in relatively confined spaces.

The challenges posed by the SARS-CoV-2 virus and resulting COVID-19 disease were recognized by the World Health Organization when the outbreak was declared a Public Health Emergency of International Concern in January 2020 and a pandemic in March.[3] The United States declared a national emergency on March 13, 2020,[4] after which school classes were shifted to online instruction at most institutions nationally. The resumption of in-person instruction for the fall 2020 semester, in the safest possible manner, would require the establishment of a multidisciplinary team to develop and implement public health measures. Baylor University is one such institution of higher education that commenced with development of strategic priorities using a team-based approach[5] (Supplement Figure 1).

Baylor University was chartered in 1845 in Waco, Texas, United States, and is a private nonprofit Christian university. As of fall 2020, Baylor had 19,297 students (14,399 undergraduates and 4,898 students in graduate and professional programs) with 4,736 living on campus. Overall, the in-session Baylor community of students, faculty, and staff was approximately 22,700 individuals. Baylor University is located in McLennan County, which has an estimated 256,600 residents.[6]

Baylor's multidisciplinary team applied a population-based management.[7] This was complemented by a "Swiss Cheese" risk mitigation model[8] which implies that the presence of any weakness or hole in any single layer (e.g., inadequate monitoring of systems) is offset by the strengths of another intervention layer (e.g., environmental engineering).[9] This approach recognizes that no one group (e.g., administration, communications, support services, health center, etc.) possesses all the expertise required to mitigate the effects of the pandemic while sustaining local business operations.[10]

CONTACT Mark Brickhouse mark_brickhouse@baylor.edu Baylor Health Services, Baylor University, McLane Student Life Center, 209 Speight Avenue, One Bear Place #97066, Waco, TX 76798, USA; Michael P. Muehlenbein michael_muehlenbein@baylor.edu Department of Anthropology, Baylor University, Marrs McLean Science Building, 1214 S. 4th Street, One Bear Place #97173, Waco, TX 76798, USA.

Supplemental data for this article can be accessed online at https://doi.org/10.1080/07448481.2022.2155062

The present study focuses on the activities of the contact tracing and wellness teams. A robust contact tracing team was established early on in planning to re-open. This team was expanded during the pandemic to include a wellness team that contacted individuals in isolation to check on their status and needs. Both teams worked closely with the contact tracers and used a Microsoft Teams portal to identify current isolation cases, allow team members to self-select positive cases to contact, to provide a common portal for posting concerns and requests, and to coordinate responses to the needs of those in isolation. The present study shares the findings from this work, providing a template for understanding long-COVID-19 in young adult populations, and demonstrating how similar institutions can provide support and care, and sustain operations during a global pandemic and other emergency situations.

Methodology

Baylor University utilized Qualtrics to query its isolation cases on their health, physical needs, vaccination status, and to provide an opportunity for them to provide feedback on Baylor support. This included a 30-day follow-up survey to determine longer-term health effects of COVID-19. The surveys were provided to in-isolation cases at Baylor between March 20 and May 19, 2021 by individual email invitations. The present report uses anonymized data from the surveys to summarize responses to questions on COVID-19 symptoms, vaccination status, demographics, isolation experiences, and qualitative responses to questions on the quality of Baylor's COVID-19 response. The current study was exempt from Institutional Review Board (IRB) approval (Baylor reference #1883416) because it used preexisting data from a de-identified dataset.

Qualtrics survey

Qualtrics is available to all official Baylor faculty, staff, as well as students when supervised by faculty in a class or research setting, in order to create, deliver, and analyze surveys and survey responses for academic, administrative, and research related purposes. Use of Qualtrics is subject to the terms and conditions set forth in these Terms of Use as well as all federal, state, local, and other applicable law; all University rules and policies, including the Technology Systems Usage Policy (BU-PP 025), found at http://www.baylor.edu/bupp; and all applicable contracts and licenses, including the Acceptable Use Statement issued by Qualtrics at http://www.qualtrics.com/acceptable-use-statement/. All materials distributed through the Qualtrics system complied with federal copyright law, http://www.copyright.gov/title17/, and Baylor's Copyright Guidelines found at http://www.baylor.edu/copyright/.

The survey was developed in early 2021, following an earlier version used to query post-isolation cases in fall 2020. The spring 2021 survey had a total of 42 questions; the full text of the survey is provided in the Supplementary Materials. Questions in the survey fell into several categories: isolation conditions, COVID-19 experience, vaccination status, demographics and qualitative feedback. The survey took approximately 15 minutes to complete and used skip logic to maintain expeditious flow.

Distribution

There were a total of 478 survey invitations sent by email to Baylor students, faculty, and staff in isolation for a positive SARS-CoV-2 test, between March 20 and May 19, 2021. Eighteen survey invitations were duplicates. The survey results presented here represent the anonymized feedback of 309 survey respondents (65% of isolation cases).

The Qualtrics distribution lists included full name, email address, phone number, and Baylor identification number. All potential respondents were drawn from the positive cases being tracked by the Contact Tracing Team using the Microsoft Teams portal. A separate Surveys page was established within Teams, and the was updated daily with new positive cases.

The following email invitation with the survey link was sent to positive cases on Day 7 of their isolation: "Baylor Health is surveying all students, staff, and faculty in isolation in the 2020/2021 school year, after testing positive for COVID-19. Please complete this survey, link below, at your earliest convenience before leaving isolation. We will be in touch within the next 24 hours to assist with completion of the survey, which we are requiring for all isolation cases. There will also be a follow-up survey in about one month to track your post-isolation health status. Your responses will help to determine the impacts of COVID-19 on the Baylor community and to further improve our response to the pandemic. Thank you for your time and support to the University."

Survey team

The Survey Team included individuals who had previously worked as contact tracers and as Wellness Checkers, who periodically contacted isolation cases to check on their health status and any needs of assistance. The Survey Team tracked the responses to the survey through Qualtrics daily and updated the Surveys Team sheet with all survey respondents. Team members sent reminders to non-respondents through Day 10 of their isolation. This was effective in raising the response rate of the survey to 65%.

Statistics

General descriptive statistics are presented using the Qualtrics Report feature. Inferential statistics were conducted using the R statistical program.[11] Logistic regression using the *glm()* function was used to explore predictors of symptomatic infection among students and faculty/staff in isolation. Specifically, the variable representing reported asymptomatic (coded 0) versus symptomatic (coded 1) infection was regressed on age, sex, and vaccine status at the time of the in-isolation survey.

Additional analyses were conducted to examine whether age, sex, or vaccine status were related to the severity of symptoms among those who reported them. A latent class analysis (LCA) was performed using MPlus statistical software (version 8)[12] to identify individuals who clustered together based on the overall severity of their symptoms. The only symptom excluded in the LCA was bluish lips and face due to low variability in this item; all other 21 symptoms were included. Per convention, final class size was determined by Bayesian Information Criterion (BIC), sample-sized adjusted BIC (SABIC), Akaike Information Criterion (AIC), the entropy statistic, the Vuong-Lo-Mendell-Rubin (VLMR) likelihood ratio test (LRT), and a parametric bootstrapped LRT.[13] Better-fitting models are indicated by lower BIC, SABIC, and AIC values, entropy exceeding 0.80, and significant VLMR-LRT and bootstrapped LRT values (i.e., relative to *N*-1 classes).

Multiple regression was also used to explore whether age, sex, vaccine status, or symptom severity (see LCA classes) predicted symptom duration. The final set of analyses examined predictors of vaccination at the time of the isolation and post-isolation surveys. In addition to age and sex, whether or not the participant sought professional medical consultation or used over-the-counter medications before or during isolation were included as predictors of vaccine status. These latter two variables were added as proxies of general desire to pursue COVID-19 treatments and therapies.

Results

Demographics

The majority of survey respondents were on-campus students, and 95.4% of all respondents were students. This is in line with the analysis of positive cases from fall 2020 that found 90.0% of positive cases on campus were students and athletes. From March 20 to May 19, 2021, there were 77,557 SARS-CoV-2 tests conducted among Baylor faculty, staff, students, and contractors. Within this group, 434 people tested positive, with a positivity rate of 0.56%. There were seven self-reports. The following tested positive for COVID-19: 434 students, 22 athletes, 14 staff, five faculty, and seven contractors. The seven self-reports included six staff and one faculty member (athletes were traced and supported separately from the general student population and were not contacted for this survey). Of the respondents, 62.4% were female, also in line with the overall student population on campus (approximately 60% female, 40% male).

Isolation conditions

Most respondents isolated in their own apartments (off-campus students; 36.1%) or campus-provided isolation housing (on-campus students; 33.4%). Many local students, and all faculty and staff respondents, isolated at their family home (27.1%). The decision to isolate at home was driven mainly by proximity, but relative ease of completing isolation and family concerns were also major drivers. On-campus students who used campus-provided isolation housing reported a 76% satisfaction rate with provided housing (scored 0-100). Off-campus students reported that inability to exercise/go outside and emotional distress/loneliness were the major challenges to isolation.

Only 9.6% of respondents reported needing assistance while in isolation. These requests were received by the contact tracers or wellness checkers who were in communication with the positive cases during their isolation. Requests were posted on the [BLINDED] Contact Tracing Microsoft Teams page and were usually flagged to individuals from the Care Team, Bear Aid, or the Health Center based on the nature of the request. The vast majority of requests for assistance were for food or grocery support. Respondents reported a 68% satisfaction level with Baylor's response to their requests (scored 0-100).

COVID-19 experience: Frequency and severity of in-isolation and post-isolation symptoms

While in isolation, 74.7% of respondents reported experiencing COVID-19 symptoms, and 80.3% reported symptoms beginning prior to their positive COVID-19 test result. Flu-like symptoms of fatigue, nasal congestion, dry cough, persistent headache, and sore throat were the most commonly experienced symptoms (Table 2). Results revealed that neither age (b = −0.01, SE = 0.02, t = −0.28, p = 0.78, OR = 0.99, 95% CI [0.96, 1.03]) nor sex (b = 0.34, SE = 0.28, t = 1.20, p = 0.23, OR = 1.41, 95% CI [0.80, 2.46]) were significant predictors of whether or not someone was symptomatic or asymptomatic. As expected, however, those who reported being vaccinated did exhibit considerably lower odds of symptoms (see below), b = −1.12, SE = 0.31, t = −3.59, p = 0.0003, OR = 0.33, 95% CI [0.18, 0.60].

Temporary loss of smell was the most severe symptom experienced by the respondent isolation cases (Table 2), consistent with qualitative reporting during contact tracing and wellness checks of unusual loss of smell and its effects on appetite. Results of the latent class analysis of symptom severity revealed an optimal 2-class solution (see Table 1 for model comparison). The first class, henceforth referred to as the "mild" group, consisted of 53.90% of the symptomatic sample and had lower mean levels of all symptoms than the "moderate/severe" group. Results of logistic regression analysis revealed that symptom severity was not predicted by age (b = 0.001, SE = 0.02, t = 0.10, p = 0.99, OR = 1.00, 95% CI [0.95, 1.05]), sex (b = −0.04, SE = 0.32, t = −0.12, p = 0.90, OR = 0.96, 95% CI [0.51, 1.80]), or vaccine status (b = 0.31, SE = 0.41, t = 0.75, p = 0.46, OR = 1.36, 95% CI [0.61, 3.05]). Thus, while individuals vaccinated prior to isolation were less likely to develop symptoms at all, vaccination status did not predict severity of symptoms among the symptomatic.

Table 1. Fit indices for latent class analysis.

Classes	AIC	BIC	SABIC	Entropy	VLMR-LRT	BOOT-LRT
1	22675.17	22812.16	22685.39	–	–	–
2	22064.07	22272.99	22079.67	0.858	<0.001	<0.001
3	21950.92	22231.77	21971.89	0.865	0.6959	<0.001

Note. AIC = Akaike information criterion, BIC = Bayesian information criterion, SABIC = sample-size adjusted BIC, VLMR-LRT = Vuong-Lo-Mendell-Rubin likelihood ratio test, BOOT-LRT = bootstrapped LRT.

Table 2. Frequency and severity of symptoms among symptomatic participants.

	During isolation (n = 230)		End of isolation (n = 92)	
Symptom	Frequency	Severity	Frequency	Severity
Fever	63.5%	28.38 (27.62)	29.3%	23.37 (28.09)
Fatigue	90.4%	46.99 (26.75)	54.3%	37.42 (24.32)
Dry cough	78.3%	36.92 (26.57)	56.5%	29.23 (26.62)
Shortness of breath	60.4%	28.09 (25.65)	28.3%	25.88 (28.99)
Pains or pressure in chest	48.3%	28.02 (29.22)	26.1%	26.96 (31.76)
Chills	60.9%	34.85 (24.31)	26.1%	20.54 (25.16)
Repeated shaking	30.0%	18.14 (24.01)	14.1%	10.77 (25.08)
Muscle pain	58.3%	39.38 (28.10)	29.3%	29.11 (26.96)
Persistent headache	74.8%	46.40 (27.59)	45.7%	32.50 (29.25)
Nasal congestion	86.5%	46.88 (27.45)	63.0%	34.95 (26.66)
Sore throat	70.0%	34.76 (26.23)	31.5%	26.62 (26.61)
Nausea	39.6%	33.25 (28.25)	19.6%	26.50 (28.59)
Vomiting	22.6%	15.31 (25.03)	12.0%	15.00 (30.39)
Diarrhea	35.2%	24.42 (28.18)	18.5%	18.47 (27.41)
Temporary loss of taste	52.2%	47.14 (33.64)	47.8%	46.70 (35.05)
Temporary loss of smell	57.4%	53.30 (31.66)	56.5%	50.83 (33.15)
Inability to stay awake	39.1%	31.18 (27.25)	23.9%	21.18 (24.27)
Confusion	27.4%	22.54 (27.87)	17.4%	11.31 (22.23)
Bluish lips or face	14.8%	5.18 (17.47)	65.2%	0.27 (1.55)
Elevated breathing rate	20.0%	18.09 (25.85)	15.2%	13.79 (26.12)
Burning or redness in eyes	25.2%	30.64 (32.97)	16.3%	14.93 (23.91)
Other	7.0%	24.44 (32.16)	5.4%	23.8 (32.69)

Note. Shown for severity are means and standard deviations (parentheses)..

Reported duration of symptoms resemble a skewed normal distribution curve around a mean duration of 4-6 days. Isolation cases were asked if they were still experiencing symptoms during the Day 7-10 window when they received the survey. More than 40% reported that they were still experiencing symptoms, consistent with the 32.9% who reported experiencing symptoms for 6-8 days or longer. The most commonly reported symptom at this time was bluish lips or face (Table 2), while the temporary loss of smell remained the most severe symptom experienced toward the end of isolation.

At the time of the in-isolation survey, symptomatic individuals reported whether their symptoms had lasted 1–2, 2–4, 4–6, 6–8, or longer than 8 days (scored 1–5). Results revealed that older age ($b = 0.03$, SE = 0.01, $t = 2.29$, $p = 0.02$), being male ($b = 0.50$, SE = 0.16, $t = 3.11$, $p = 0.002$), and having more severe symptoms ($b = 0.55$, SE = 0.16, $t = 3.56$, $p = 0.0005$) were also associated with longer symptom duration. While vaccinated participants were more likely to report being asymptomatic, vaccine status was not significantly related to the length of symptoms before and during isolation ($b = -0.24$, SE = 0.21, $t = -1.15$, $p = 0.25$).

A follow-up survey was sent thirty days after isolation, with a lower response rate (24% vs. 65%) and a different respondent composition: 84.2% of the follow-up survey respondents were students (down from 95.4%), and 71.0% of the follow-up survey respondents were female (up from 62.4%). More than 31% of follow-up survey respondents reported still experiencing COVID-19 symptoms after leaving isolation. Temporary loss of smell, fatigue, persistent headache, dry cough, and temporary loss of taste all persisted for over three weeks on average. The average severity of post-isolation symptoms was lower than those experienced in isolation. However, it is notable that one of the less common symptoms, tachycardia, was reported as among the most severe of the post-isolation symptoms.

More than four weeks after isolation, 11.3% of respondents still reported symptoms, although this represents only 13 individuals. One individual reported tachycardia that had persisted for 10 weeks. Otherwise, temporary loss of taste and smell were the most persistent symptoms. Two individuals reported confusion that lasted more than two weeks, and which was the most severe of the long-term symptoms.

Logistic regression analysis revealed that males ($b = 1.63$, SE = 0.76, $t = 2.14$, $p = 0.03$, OR = 5.12, 95% CI [1.28, 27.19]) and those who experienced more severe symptoms ($b = 1.25$, SE = 0.57, $t = 2.17$, $p = 0.03$, OR = 3.49, 95% CI [1.16, 11.31]) were more likely to report lingering symptoms 30 days after isolation. Those who were vaccinated, on the other hand, were less likely to have symptoms remaining post-isolation ($b = -1.25$, SE = 0.57, $t = 1.97$, $p = 0.049$, OR = 0.29, 95% CI [0.08, 0.95]). A visual depiction of differences in average length of each lingering symptom between vaccinated and unvaccinated participants is displayed in Supplement Figure 2. Age was not significantly related to post-isolation symptoms ($b = 0.04$, SE = 0.03, $t = 1.36$, $p = 0.17$, OR = 1.04, 95% CI [0.99, 1.12]).

Vaccination status

During the in-isolation survey period from March 20 to May 19, 2021, only 20.7% reported that had received a COVID-19 immunization, although it was still early in the nationwide vaccine campaign and rollout. The Pfizer vaccine was the most commonly received, and at the time of their isolation, only 11% of positive cases had received their second dose of a two-dose mRNA vaccine.

For vaccination prior to isolation, higher odds were found for older individuals ($b = 0.04$, SE = 0.02, $t = 2.39$, $p = 0.02$, OR = 1.05, 95% CI [1.01, 1.09]) and those who reported seeking medical consultation upon testing positive ($b = 0.74$, SE = 0.31, $t = 2.40$, $p = 0.02$, OR = 2.10, 95% CI [1.15, 3.88]). Contrary to the findings for seeking medical consultation, participants who reported using over-the-counter treatments had lower odds of vaccination ($b = -0.84$, SE = 0.32, $t = -2.66$, $p = 0.01$, OR = 0.43, 95% CI [0.22, 0.79]). Sex did not significantly predict vaccination at the time of the in-isolation survey ($b = 0.54$, SE = 0.32, $t = 1.66$, $p = 0.10$, OR = 1.71, 95% CI [0.92, 3.29]).

By the time of the follow-up survey, 40.9% of former isolation cases had received a COVID-19 immunization, with 44.6% of the unvaccinated reporting that they wanted to receive the vaccine; 58.0% reported that they wanted to receive the vaccine during the in-isolation survey.

For vaccine status 30 days post-isolation, age ($b = -0.04$, SE = 0.06, $t = -0.72$, $p = 0.47$, OR = 0.96, 95% CI [0.80, 1.04]), sex ($b = -0.06$, SE = 0.75, $t = -0/08$, $p = 0.94$, OR = 0.94, 95% CI [0.22, 4.49]), and seeking medical consultation ($b = -0.55$, SE = 0.78, $t = -0.70$, $p = 0.48$, OR = 0.58,

95% CI [0.11, 2.52]) did not reach statistical significance. The effect of over-the-counter medication use trended toward significance (b = −1.32, SE = 0.69, t = −1.92, p = 0.054, OR = 0.27, 95% CI [0.06, 0.99]) with those using these treatments having lower odds of vaccination.

From the in-isolation survey, 39.7% of those who had received a vaccination reported experiencing post-injection symptoms (Supplement Table 1). Overall post-vaccination symptom severity was somewhat lower than in-isolation COVID-19 symptoms; the most common symptoms were more flu-like than COVID-19 symptoms, with loss of taste and smell much less common and severe.

Vaccination hesitancy and treatments

The in-isolation and 30-day follow-up surveys both indicated a relatively high level of vaccine hesitancy amongst the COVID-19 positive, isolation cases. Both surveys asked why they would not want to be vaccinated, with many responses and several common themes about assumptions of naturally-acquired immunity, concern about side-effects, and questions about vaccine safety. Fortunately, these numbers have changed dramatically with now more than 80% of the student population and 90% of the faculty and staff population fully vaccinated. This is a substantial accomplishment of the University and the Baylor community with an overall vaccination rate considerably higher than State and local vaccination rates.

62.2% of cases reported consulting a medical practitioner before or during isolation. The frequencies of treatments recommended by healthcare practitioners are located in Supplement Figure 3 and the frequencies of over-the-counter medication use are located in Supplement Figure 4. Our understanding of the effectiveness of therapeutics has advanced significantly since this survey was completed.

Qualitative responses and feedback on Baylor response to COVID-19

Respondents generally reported overall satisfaction with the Baylor processes, with a 77% satisfaction (from zero for completely dissatisfied to 100 for completely satisfied) on their rating of how faculty or supervisors accommodated coursework or jobs during isolation; over 180 open-ended responses indicated general support from faculty and supervisors. Respondents reported a 82% satisfaction with their contact tracer(s), a 78% satisfaction with the Health Center, and an 80% satisfaction with the Wellness team, frequently praising the work of the contact tracers, Health Center, Bear Aid, and Care Team for providing information, coursework, and emotional support and physical assistance with needs such as food and supply deliveries.

Discussion

Baylor University established a surveillance system using Qualtrics surveys to identify the health, physical needs, and vaccination status of isolating cases as well as an opportunity for them to provide feedback on available support. Findings include the severity and rate of occurrence of COVID-19, their persistence over 30 days, the vaccination status of isolation cases in spring 2021, issues encountered during isolation, and recommendations for improving support.

The results presented here come from 309 survey respondents (65% of isolation cases invited between March 20 and May 19, 2021). Obviously, this limited sample size prohibits any conclusions from being extended to the general population. We do however identify several trends that may be replicable at other institutions and using other young adult populations in some higher income countries. For example, we experienced most respondents isolating in their own apartments (off-campus students), with a majority reporting emotional distress/loneliness as the major challenges to isolation. When provided with isolation housing for on-campus students, a relatively high satisfaction rate can be achieved although this requires a tremendous amount of planning, management, and institutional financial support. In the present case, less than 10% of respondents needed additional assistance while in isolation, and satisfaction with responses from faculty/supervisors, contact tracers, and the health and wellness teams was relatively high. Baylor University ended up investing an enormous amount of time and financial resources in supporting isolating individuals.

The current results also contribute to the general understanding of COVID-19 disease, in particular the many problems with longer-COVID-19 in a young adult population. Much of the research on the symptoms and experience of COVID-19 disease, particularly concerning longer-term symptoms, has been on more severely ill cases that required hospitalization and/or time in an intensive care unit.[14] There has been much less research on the experience of younger, relatively less severe COVID-19 cases who generally recovered mostly while in isolation. Such reports often focus on mental health impacts[15] and include fewer details on the physiological symptoms experienced by the isolation cases.[16]

In the present case, the majority of respondents experienced COVID-19 symptoms while in isolation. In the follow-up survey (with a lower response rate) almost 32% of respondents were still experiencing symptoms after leaving isolation. Temporary loss of smell, fatigue, persistent headache, dry cough, and temporary loss of taste all persisted for over three weeks. Older age, being male, and having more severe symptoms were all associated with longer symptom duration. Males and those who experienced more severe symptoms were more likely to report lingering symptoms 30 days after isolation. If such results were replicated in other situations, it may be useful to identify those at higher risk in such institutional settings.

Less than 21% of our sample received a COVID-19 immunization, in part because the nationwide vaccine campaign and rollout was still at the early stages of implementation. However, even our small sample size revealed that those vaccinated did exhibit considerably lower odds of developing symptoms. Furthermore, they were less likely to continue to have symptoms lingering after isolation. While vaccinated participants were more likely to report

being asymptomatic, vaccine status was not significantly related to the length of symptoms before and during isolation, and vaccine status did not predict severity of symptoms. Such limited results do not undermine the efficacy and importance of being vaccinated against the SARS-CoV-2 virus.

Although our collective knowledge about the prevention of SARS-CoV-2 infection and treatment of COVID-19 disease has improved significantly since our survey was implemented, there was a trend toward those who self-medicate (using over-the-counter drugs) to be less likely to be vaccinated, a trend that may be continuing today in light of the spread of misinformation about the pandemic. It is hopeful that we learn more about how to effectively communicate during this continued pandemic and other emergency situations.

Acknowledgments

Listed in alphabetical order, the following individuals played various important roles in the collection and maintenance of the data used here: Jon Allen, Joshua Been, Kenneth Boyd, Nancy Brickhouse, Matthew Burchett, Jason D. Cook, Lori Fogleman, Peter Granick, Sharra Hynes, Tonya Hudson, Michelle Huse, Micah Lamb, Tiffany Lowe, Jim Marsh, Niesha Nixon, Dennis Nolan, George Nuñez, Sharon Stern, and Meaghann Wheelis. Support for the mitigation strategies implemented and sustaining university operations was provided by President Linda Livingstone, the President's Council, and the Board of Regents of Baylor University. Expert advice was offered by representatives from Accountable Health and Waco-McLennan County Public Health District. The university could not have operated without the commitment and support of the Waco community.

Author contributions

MB conceived the project; MPM and MB designed the wellness data collection plan; BJR facilitated data collection; JG and MB conducted the analyses; MB drafted the manuscript; and all authors revised the final manuscript.

Conflict of interest disclosure

The authors have no conflicts of interest to report. The authors confirm that the research presented in this article met the ethical guidelines, including adherence to the legal requirements, of the United States of America and received exemption from the Institutional Review Board of Baylor University.

Funding

Funding for this project was provided by Baylor University.

ORCID

Michael P. Muehlenbein http://orcid.org/0000-0003-1332-6264

Data availability statement

De-identified data can be made available to researchers upon reasonable request.

References

1. Brooks-Pollock E, Christensen H, Trickey A, et al. High COVID-19 transmission potential associated with re-opening universities can be mitigated with layered interventions. *Nat Commun*. 2021;12(1):5017. doi:10.1038/s41467-021-25169-3.
2. CDC. COVID-19 and Your Health. Centers for Disease Control and Prevention. Published February 11, 2020. Accessed February 23, 2022. https://www.cdc.gov/coronavirus/2019-ncov/faq.html
3. World Health Organization. Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV). Accessed May 20, 2020. https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)
4. Proclamation on Declaring a National Emergency Concerning the Novel Coronavirus Disease (COVID-19) Outbreak – The White House. Accessed March 14, 2022. https://trumpwhitehouse.archives.gov/presidential-actions/proclamation-declaring-national-emergency-concerning-novel-coronavirus-disease-covid-19-outbreak/
5. Ryan BJ, Muehlenbein MP, Allen J, et al. Sustaining University Operations During the COVID-19 Pandemic. *Disaster Med Public Health Prep*. Published online March 8, 2021:1–9. doi:10.1017/dmp.2021.69.
6. U.S. Census Bureau. U.S. Census Bureau QuickFacts: Waco City, Texas. Accessed December 1, 2020. https://www.census.gov/quickfacts/wacocitytexas
7. Burkle FM, Bradt DA, Ryan BJ. Global public health database support to population-based management of pandemics and global public health crises, part I: The concept. *Prehospital Disaster Med*. 2021;36(1):95–104. doi:10.1017/S1049023X20001351.
8. Seshia SS, Bryan Young G, Makhinson M, Smith PA, Stobart K, Croskerry P. Gating the holes in the Swiss cheese (part I): Expanding professor Reason's model for patient safety. *J Eval Clin Pract*. 2018;24(1):187–197. doi:10.1111/jep.12847.
9. Cleveland Clinic. Advice on Reopening Business: Frequently Asked Questions Cleveland Clinic. Accessed December 20, 2020. https://my.clevelandclinic.org/-/scassets/files/org/employer-solutions/covid-19-workplace-safety-faqs.pdf
10. Wirth M, Rauschenbach L, Hurwitz B, Schmiedebach HP, Herdt JA. The Meaning of Care and Ethics to Mitigate the Harshness of Triage in Second-Wave Scenario Planning During the COVID-19 Pandemic. *Am J Bioeth*. 2020;20(7):W17–W19. doi:10.1080/15265161.2020.1777355.
11. R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Published online 2019. https://www.R-project.org/
12. Muthén LK, Muthén BO. Mplus User's Guide. Eighth Edition. Published 2017 1998. Accessed November 8, 2020. https://scholar.google.com/scholar_lookup?title=Mplus%20user%27s%20guide%3A%20Seventh%20edition&author=L.K.%20Muth%C3%A9n&publication_year=1998-2012
13. McCutcheon AL. *Applied Latent Class Analysis*. Cambridge, MA: Cambridge University Press; 2002.
14. Fortini A, Torrigiani A, Sbaragli S, et al. COVID-19: persistence of symptoms and lung alterations after 3-6 months from hospital discharge. *Infection* 2021;49(5):1007–1015. doi:10.1007/s15010-021-01638-1.
15. Fruehwirth JC, Biswas S, Perreira KM. The Covid-19 pandemic and mental health of first-year college students: Examining the effect of Covid-19 stressors using longitudinal data. *PLoS One*. 2021;16(3):e0247999. doi:10.1371/journal.pone.0247999.
16. Hayden ME, Rozycki D, Tanabe KO, et al. COVID-19 isolation and quarantine experience for residential students at a large four-year public university. *Am J Public Health*. 2021;111(10):1772–1775. doi:10.2105/AJPH.2021.306424.