

COVID-19 Vaccine Hesitancy in a US Public University Cohort

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Abstract

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COVID-19 is a threat to university reopening. Universities are sites of dense human contact, congregate living, and heterogeneous mixing patterns that may increase risk of viral transmission within and between social groups. Understanding attitudes toward vaccine uptake is critical to strategic reopening. At the University of Washington, we conducted a prospective observational study of SARS-CoV-2 surveillance in faculty, staff, and students (n=17,994) between 09-Sep-2020 and 27-Jan-2021. Demographic characteristics and attitudes toward vaccination were collected at baseline and followed-up among the same cohort. Participants were asked to complete daily electronic check-ins (email or text) to assess symptoms and risk factors. At baseline, 14,353 (79.8%) were vaccine receptive and 3,641 (20.2%) were vaccine hesitant (responded that when the COVID-19 vaccine becomes available to them, they would not plan to get vaccinated, or were uncertain).

Of the 3,641 who were vaccine hesitant at baseline, 2,360 (64.8%) participants were followed-up to reassess attitudes in the time period after FDA Emergency Use Authorization (EUA) of two SARS-CoV-2 vaccines using mRNA formulations (Pfizer, Moderna). Among the 2,360 who were followed-up, 649 (27.5%) were hesitant at follow-up (continued hesitancy). In an analysis using multivariate regression, we observed that continued hesitancy was relatively more common among Black (PR 1.97, 95% CI 1.52-2.54) and Asian (PR 1.56, 95%CI 1.31-1.85) respondents than among Whites; persons who reported non-receipt of prior year's influenza vaccine (PR 1.73, 95%CI 1.49-2.01); and residence outside Seattle

city limits (PR 1.52, 95%CI 1.27-1.84). Faculty status was associated with a lower likelihood of continued hesitancy (PR 0.45, 95%CI 0.25-0.82, compared to students). Students in Greek congregate living were somewhat more likely to remain hesitant than those living off-campus (PR 1.29, 95%CI 0.99-1.78).

In this cohort of university staff, students, and faculty, continued vaccine hesitancy after vaccine EUA was relatively more common in persons at higher risk for COVID-19 infection and transmission. Understanding hesitancy patterns is important for university reopening and campus public health planning.

1 Introduction

Vaccine hesitancy is a long-known issue, and defined by the World Health Organization (WHO) SAGE Working Group(1): “Vaccine hesitancy refers to delay in acceptance or refusal of vaccination despite availability of vaccination services. Vaccine hesitancy is complex and context specific, varying across time, place, and vaccines. It is influenced by factors such as complacency, convenience and confidence.” Hesitancy against SARS-CoV-2 vaccines may threaten university reopening efforts. United States (US) universities are places of high transmission due to congregate living(2), highly social activities and in-person instruction(3). University COVID-19 outbreaks were previously managed without vaccines(4), but many will adopt vaccine recommendations or requirements in Autumn 2021(5). Understanding local predictors of hesitancy is key to crafting strategy and communication to both hesitant and receptive groups of university staff, faculty, and students for safe reopening(1). Prior cross-sectional studies identified correlates of vaccine hesitancy in the US prior to the FDA Emergency Use Authorization (EUA) for SARS-CoV-2 vaccines(6)(7). Since the EUA allowed national vaccine distribution(8)(9), context changed substantially. It is unknown what degree of vaccine hesitancy remains on campus since that change. This secondary analysis within the Husky Coronavirus Testing Study (HCT)(10) at the University of Washington (UW) describes continued hesitancy in a longitudinal study within a cohort of students, staff, and faculty at a large, public US state university. Prior US-based longitudinal studies have not yet addressed the time period after vaccine EUA(11), and focused only on students(12)(13). This analysis aimed to understand key areas of vaccine hesitancy in a diverse university population to drive vaccine demand and to keep group immunity levels high.

2 Methods

2.1 Study design

This is an analysis of data gathered in a prospective cohort study of COVID-19 surveillance, described by Weil et al(10), and was designed to assess baseline SARS-CoV-2 vaccine hesitancy at enrollment, and again at follow-up (defined here as continued hesitancy). The HCT is a longitudinal study with

contactless enrollment, that uses daily email or short message service (SMS) surveys to collect daily attestations from participants that record self-reported COVID-19-like symptoms, exposure to SARS-CoV-2 positive contacts, and presence at high risk gatherings, and offers testing for SARS-CoV-2(10). A comprehensive enrollment survey was conducted to record demographic characteristics, university affiliation, information about living situation (location, number of roommates, type of housing), campus attended (main or one of two satellite campuses 15 and 35 miles from the main campus), time spent working from home, time spent on campus, underlying comorbidities (asthma, COPD, bronchitis, cancer, diabetes, heart failure or attack, high blood pressure, immunosuppression), practice of recommended public health behaviors (hand-washing, mask wearing, social distancing), receipt of prior vaccines, vaccine attitudes, and a baseline SARS-CoV-2 test was offered. The study was approved from 01-Sep-2020 to 31-Aug-2021 by the UW Institutional review board. First enrollment was 2020-09-23, and data were extracted for this secondary analysis on 27-Jan-2021. Follow-up surveys were distributed to all participants to assess changes in vaccine uptake behaviors and attitudes, university affiliation, residence (location, number of housemates), time spent working from home, time spent on campus, prior SARS-CoV-2 test status, hygiene, masking, and social distancing behaviors, and travel history. Follow-up surveys were distributed according to university affiliation (02-Jan-2021 for faculty and staff, 04-Jan-2021 for students).

2.2 Setting

The University of Washington is a large, publicly funded university with 59,381 students, 4,864 faculty, and 26,229 staff in academic year 2019-2020(14). COVID-19 pandemic conditions required suspension of non-essential in-person work and instruction beginning March 2020 and continuing through Summer 2021. The university has one main (enrollment 48,126) and two satellite campuses, A (35 miles south, enrollment 5,369) and B (15 miles north, enrollment 6,289).

2.3 Study subjects

Students of all levels, staff, faculty, volunteers, were eligible to enroll in the study. Participants were drawn from the entire UW population including the main campus and both satellite campuses.

Recruitment occurred through several routes: university emails and newsletters, social media, flyers,

announcements, physical signs, and links to the study's website on an official UW webpage. Eligibility criteria were age over 13 years (participants between 13 and 17 years required parental/guardian consent), attending UW at least one day per month, either in-person or remotely, living in Seattle, Bothell or Tacoma areas (assessed by current zip code), willingness to comply with all study procedures, including daily surveillance and illness swabs in the event of an illness episode, English speaking, and having a residence on campus or a permanent mailing address to receive necessary mailed materials. Exclusion criteria were living outside the specified geographic area (approximately 100 miles around each campus), or age under 13 years. Consent was done through web portal with a UW NetID (university identification) to screen for university affiliation and ensure internet capabilities.

The study sought to recruit 8,000 individuals in each of three risk tiers through the end of June 2021 (see appendix). Students in UW Greek Life (Registered Student Organizations with high levels of socialization and congregate living) were encouraged to participate by Hellenic leadership due to the high risk of outbreak in that community.

2.4 Data collection

Only data that were obtained in monthly surveys and in daily attestations marked as "complete" were analyzed. Vaccine hesitancy was assessed at both baseline and at follow-up (defined as continued hesitancy) from the question: "When the COVID-19 vaccine becomes available for you, do you plan to get vaccinated?" Hesitancy was defined as "no" or "undecided", and receptivity was defined as "yes" or "I have already received one/two dose(s) of the vaccine." During analysis, implausible values for ages were excluded. Continued hesitancy was defined as being coded "hesitant" at both the baseline and follow-up surveys. All analyzed data were self-reported.

2.5 Analysis

This analysis assessed predictors of continued hesitancy at follow-up during Winter 2021, among remaining members of the cohort. At baseline, categorical variables were evaluated as count and proportion, continuous variables as median and inter-quartile range (IQR). The baseline population was stratified by affiliation, and proportions of vaccine hesitancy were evaluated to inform analysis of follow-up data. At follow-up, univariate and multivariate prevalence ratios of continued vaccine hesitancy were

calculated using generalized estimating equations (working independence, Poisson family, log-link, Wald test, robust standard errors). Covariates considered *a priori* for this analysis were: university affiliation, age (years), sex assigned at birth, race, Hispanic/Latinx ethnicity, university campus (main, or one of two satellites), housing location (off campus, on campus, Greek, other), household income (or parent's, if student), receipt of last year's influenza vaccine, residence in or outside of Seattle (inside/outside city limits, at least one comorbidity status at baseline (asthma, COPD, bronchitis, cancer, diabetes, heart failure or attack, high blood pressure, immunosuppression), attained education (at least bachelor's), and baseline reason for vaccine hesitancy (safety, non-safety reason, or prefer not to say). Reasons given for vaccine hesitancy were classified as safety-related (concerns about vaccine safety, rigor of testing, or wanting more information), non-safety-related (not worried about getting sick, wanting to wait for high-risk people to receive first, or no time to get a vaccine) and some preferred not to give a reason.

Analysis was performed using R software version 4.0.3. Institutional review board approval was granted by the University of Washington. Funding was through the United States Senate and House of Representatives Bill 748, Coronavirus Aid, Relieve and Economic Security Act.

3 Results

Data from 17,994 persons were included in this analysis, including 11,776 students (67.8%), 4,001 staff (23.0%), 1,455 faculty (8.4%) and 128 others (0.7%). Students were primarily enrolled from the Seattle campus (17,076/17,994, 94.7% vs. 80.3% of all matriculated students across three campuses). Student participants were predominantly female (61.2% vs. 55.3% among all students) and White (56.8% vs. 39.1% among all students). Of an estimated 4,100 Greek-affiliated students, 2,767 (67.5%) enrolled in the study. Many UW students enrolled during Autumn 2020 (19,995/59,784, 33.4%) reported residence outside Washington state, and 14.1% were international (the HCT study did not measure domestic/international status). Participating staff members mostly reported White race (2861/4001, 71.5% vs. 53.2% among all staff). Of the 17,994 total participants enrolled in the HCT study on 27 January 2021, 3,641 (20.2%) reported baseline SARS-CoV-2 vaccine hesitancy, 14,353 (79.8%) reported receptivity, and one participant's answer was missing [Table 1]. Baseline proportions of vaccine

hesitancy were greater among staff (24.8%) compared to faculty (16.6%) and students (19.3%). A greater proportion of females reported baseline hesitancy than males (21.8% vs. 17.6%). All races reported elevated prevalence of hesitancy compared with White race (18.1%) [Table 1], and was greatest among Black (42.3%) respondents. Hispanic/Latinx respondents were somewhat more likely to express hesitancy compared with others (22.7% vs. 19.9%). Compared with those living off campus, those living on campus or in Greek housing had lower proportions reporting hesitancy. Those attending a satellite campus reported high proportions of hesitancy, as did those residing in a zip code outside Seattle city limits (26.6% vs. 19.0% inside Seattle). Reasons given for vaccine hesitancy were coded as safety-related (3,159/3,641 86.8%), non-safety-related (368/3,641 10.1%) or prefer not to say (114/3641, 3.1%). Reason for hesitancy was not assessed at follow-up.

A total of 6,094 participants at baseline were not included in the assessment of continued hesitancy [Figure 1]: 5,861 (96.2%) did not complete a follow-up survey and 233 (3.8%) were missing a response to the vaccine attitude question at follow-up. In the group that was excluded, 1,281 (21.0%) had been vaccine hesitant and 4813 (79.0%) vaccine receptive at baseline. 2,360 participants who were hesitant at baseline and remained in the study were assessed for continued hesitancy at follow-up. Of these, 649 (27.5%) remained hesitant (continued hesitancy) and the remaining 1,711 (72.5%) indicated vaccine receptivity.

After adjusting for covariates, faculty members were at lower likelihood of continued hesitancy compared to students (PR 0.45, 95%CI 0.25-0.82). Staff and students were similarly likely to remain hesitant [Table 2]. Compared to White respondents, Black, (PR 1.97, 95%CI 1.52-2.54) Asian, (PR 1.56, 95%CI 1.31-1.85) and Native Hawaiian/Pacific Islander races (PR 1.77, 95% CI 0.96-3.27) were more likely to remain vaccine hesitant. Hispanic/Latinx ethnicity, female sex, and comorbidity status were not associated with continued hesitancy. Local residence outside of Seattle was associated with an increased likelihood of continued hesitancy (PR 1.52, 95%CI 1.27-1.84), and attending Satellite Campus A was slightly associated with continued hesitancy. Persons in higher income brackets tended to have a lower likelihood of continued hesitancy compared with persons in the lowest income bracket. Residence on-campus (PR 1.22, 95%CI 0.96-1.54) and Greek housing (PR 1.32, 95%CI 0.99-1.78) were somewhat associated with continued hesitancy. Failure to receive the prior year's influenza vaccine was associated

with continued hesitancy (PR 1.73, 95%CI 1.49-2.01).

4 Discussion

Ours is the first large US public university study of students, staff, and faculty members to assess continued vaccine hesitancy following EUA within a single cohort. We observed that a large proportion – some 73 percent – of persons hesitant about receiving the SARS-CoV-2 vaccine in late 2020 changed their minds to receptivity post-EUA. Nonetheless, continued SARS-CoV-2 vaccine hesitancy is a barrier to universities reopening in Autumn 2021. Identifying groups for outreach is important in crafting and prioritizing vaccination efforts. A number of cross-sectional studies of predictors of hesitancy to receive the SARS-CoV-2 vaccine have been conducted (generally outside the university setting)(6), but the applicability of their results to the issue of persisting hesitancy is uncertain.

This analysis of university students, faculty, and staff observed greatest likelihood of continued vaccine hesitancy among Black, Asian, Hawaiian/Pacific Islanders participants and those of multiple races. We did not observe greater likelihood of continued hesitancy among Hispanic/Latinx respondents, women, or those with underlying comorbidities. Residence outside Seattle, residence on campus, residence in social congregate housing, and attendance at one satellite campus were predictors of continued vaccine hesitancy. We observed similar degrees of continued hesitancy between staff and students, and considerably less likelihood among faculty. National polls taken during the early months of 2021 reported a decrease in vaccine hesitancy post EUA(7)(11), which we also observed in a similar time period.

A smaller longitudinal US study (n=522) assessed continued vaccine trust over two survey waves among the same cohort, with both waves prior to vaccine EUA(15). Vaccine trust was assessed with the prompt, “I would not trust a vaccine for the coronavirus,” and respondents could respond on a five-level Likert scale from “strongly agree” to “strongly disagree.” Associations at follow-up were measured with adjusted odds ratios (aOR). Black respondents (aOR 0.22, 95%CI 0.08-0.56) were less likely to report vaccine trust than White respondents, but Asian respondents were not (aOR 1.04, 95%CI 0.45-2.41). Men were more likely to express trust than women (aOR 2.35, 95%CI 1.53-3.69).

Theoretical hesitancy may differ from actual vaccine uptake. King County reported heterogeneous vaccine uptake depending on local regions. Southside and rural eastern King County generally reported lower uptake than northern and western regions(16). Pierce County, which contains Satellite Campus A reported lower uptake than King County(17). Similar patterns were observed in our findings [Table 2].

This study had several limitations. First, the HCT did not recruit a representative sample of the University population, which potentially impacts the generalizability of the results. The study population was disproportionately White, female, enrolled at the main campus, and non-English speakers were excluded. Faculty were somewhat overrepresented, while staff were somewhat underrepresented. Second, the sample size was small in some sub-groups. Third, dropout was substantial. Fourth, our study population may have been overrepresented by persons who were relatively more likely to engage with public health and receive vaccines. Fifth, we did not assess political affiliation, trusted source of health information, or religiosity, important predictors of hesitancy in the US(15).

Vaccine hesitancy is a complex topic, and subject to changes in time, social, political, epidemic conditions, and vaccine availability(1)(18). Understanding local trends is important for public safety in general, and for university reopening in particular. University reopening involves balancing local vaccine acceptability, infection prevention measures and associated costs, and local adherence to recommended non-pharmaceutical interventions. Vaccines will be an important tool in a multi-pronged approach including masks, physical distancing, and continued testing(19). These results may be informative when combating misinformation(20), or when tailored education approaches are beneficial to boost vaccine uptake(21). Students in dormitories, social congregate housing, and members outside some urban centers may require continued public health attention for vaccines. Not all US universities will require vaccines, or may only require them after full FDA approval(5), so there is no best-fit strategy for all institutes of higher education.

Acceptable and cost-effective strategies are necessary to reopen universities to in-person instruction. Further work is needed to understand reasons for continued vaccine hesitancy, and changing opinions in context of evolving vaccine authorizations, political factors, and social movements.

5 Tables and Figures

Table 1: Baseline demographic characteristics of vaccine hesitancy among Husky Coronavirus Testing participants in Autumn 2020 (n=17,994).

Baseline Characteristics of HCT Study Participants		
University of Washington, 27 Jan 2021		
	N (%) ¹	
	Receptive	Hesitant
Population		
	14353 (79.8)	3641 (20.2)
University Affiliation ²		
Student	9506 (80.7)	2270 (19.3)
Staff	3007 (75.2)	994 (24.8)
Faculty	1214 (83.4)	241 (16.6)
Other	95 (74.2)	33 (25.8)
Age: years		
Median (IQR)	22.0 (20.0 to 32.0)	24.0 (20.0 to 37.0)
Age Group		
<=17	49 (87.5)	7 (12.5)
18-49	12847 (80.1)	3194 (19.9)
50-64	1173 (76.1)	368 (23.9)
65+	276 (79.8)	70 (20.2)
Sex assigned at birth		
Male	5754 (82.4)	1225 (17.6)
Female	8555 (78.2)	2384 (21.8)
Education		
Some College	3864 (79.8)	981 (20.2)
Less than High School	23 (62.2)	14 (37.8)
High School Graduate/GED	3831 (82.1)	836 (17.9)
Undergraduate Degree	3305 (78.1)	926 (21.9)
Advanced Degree	3238 (79.7)	826 (20.3)
Don't Say	91 (61.1)	58 (38.9)
Race		
White	9021 (81.9)	1999 (18.1)
Asian	3110 (78.8)	839 (21.2)

Baseline Characteristics of HCT Study Participants

University of Washington, 27 Jan 2021

	N (%) [†]	
	Receptive	Hesitant
American Indian or Alaska Native	48 (64.9)	26 (35.1)
Black or African American	247 (57.7)	181 (42.3)
Native Hawaiian or other Pacific Islander	36 (61.0)	23 (39.0)
Multiple Races	1221 (80.4)	297 (19.6)
Other	401 (73.3)	146 (26.7)
Hispanic/Latinx Ethnicity		
No	13154 (80.1)	3264 (19.9)
Yes	1093 (77.3)	321 (22.7)
UW Greek Affiliated		
No	7590 (80.4)	1850 (19.6)
Yes	2370 (82.1)	515 (17.9)
Housing ³		
Off-Campus Housing	11199 (79.2)	2934 (20.8)
On-Campus Housing	1507 (81.4)	345 (18.6)
Greek (Chapter House and Live Out)	1573 (82.2)	341 (17.8)
Shelter, transitional housing, or other	74 (77.9)	21 (22.1)
On-campus frequency this quarter		
Do not come to campus	3843 (80.0)	962 (20.0)
One day a week or less	4202 (79.9)	1059 (20.1)
Two days a week or more	5776 (79.2)	1517 (20.8)
Registered for In-Person Classes		
No	8612 (80.7)	2058 (19.3)
Yes	1369 (81.5)	311 (18.5)
Tested for SARS-CoV-2 prior to enrollment		
No	6351 (77.7)	1827 (22.3)
Yes	8002 (81.5)	1814 (18.5)
Campus		
Main Campus	13702 (80.4)	3344 (19.6)
Satellite Campus A	252 (67.9)	119 (32.1)
Satellite Campus B	398 (69.1)	178 (30.9)
Mask-wearing in the past 7 days		

Baseline Characteristics of HCT Study Participants

University of Washington, 27 Jan 2021

	N (%) ¹	
	Receptive	Hesitant
Always	13991 (79.9)	3515 (20.1)
Sometimes/Never	350 (74.2)	122 (25.8)
Six-foot social distancing in the past 7 days		
Always	10560 (80.0)	2643 (20.0)
Sometimes/Never	3776 (79.2)	991 (20.8)
Household or parent's income (if student)		
Less than \$25k	1481 (77.5)	429 (22.5)
\$26k-\$50k	1822 (78.8)	490 (21.2)
\$51k-\$75k	1515 (77.5)	441 (22.5)
\$76k-\$100k	1298 (80.0)	324 (20.0)
\$101k-\$125k	1280 (81.3)	295 (18.7)
\$126k-\$150k	915 (81.8)	203 (18.2)
More than \$150k	3203 (84.6)	583 (15.4)
Don't know/Don't say	2838 (76.4)	876 (23.6)
Received last year's influenza vaccine?		
Yes	10528 (82.4)	2252 (17.6)
No	3825 (73.4)	1389 (26.6)
Respondent currently living in Seattle? ⁴		
Zip code in Seattle	12074 (81.0)	2826 (19.0)
Zip code not in Seattle	2207 (73.4)	800 (26.6)
Comorbidity at baseline (non-allergy)? ⁵		
No	12126 (80.1)	3014 (19.9)
Yes	2171 (78.6)	590 (21.4)
Reason for vaccine hesitancy		
Safety or information reasons	0 (0.0)	3159 (100.0)
Non-safety or information reason	0 (0.0)	368 (100.0)
Don't say	0 (0.0)	114 (100.0)

¹To the baseline survey question: "When the COVID-19 vaccine becomes available for you, do you plan to get vaccinated?" Receptive = "Yes" or "I have already received one/two dose(s) of the vaccine". Hesitant = "No" or "Undecided". ²Those in the 'Other' affiliation category included postdoctoral fellows, externs, volunteers, and other university affiliates. ³A Greek 'Live Out' is a private house or apartment that is shared by members of the same Greek chapter. On-campus housing was defined as dormitories, apartments, and family units. ⁴Includes only Seattle city proper, not metro area. ⁵Allergy question was not specific to seasonal or vaccine allergy.

Figure 1: Participant flowchart

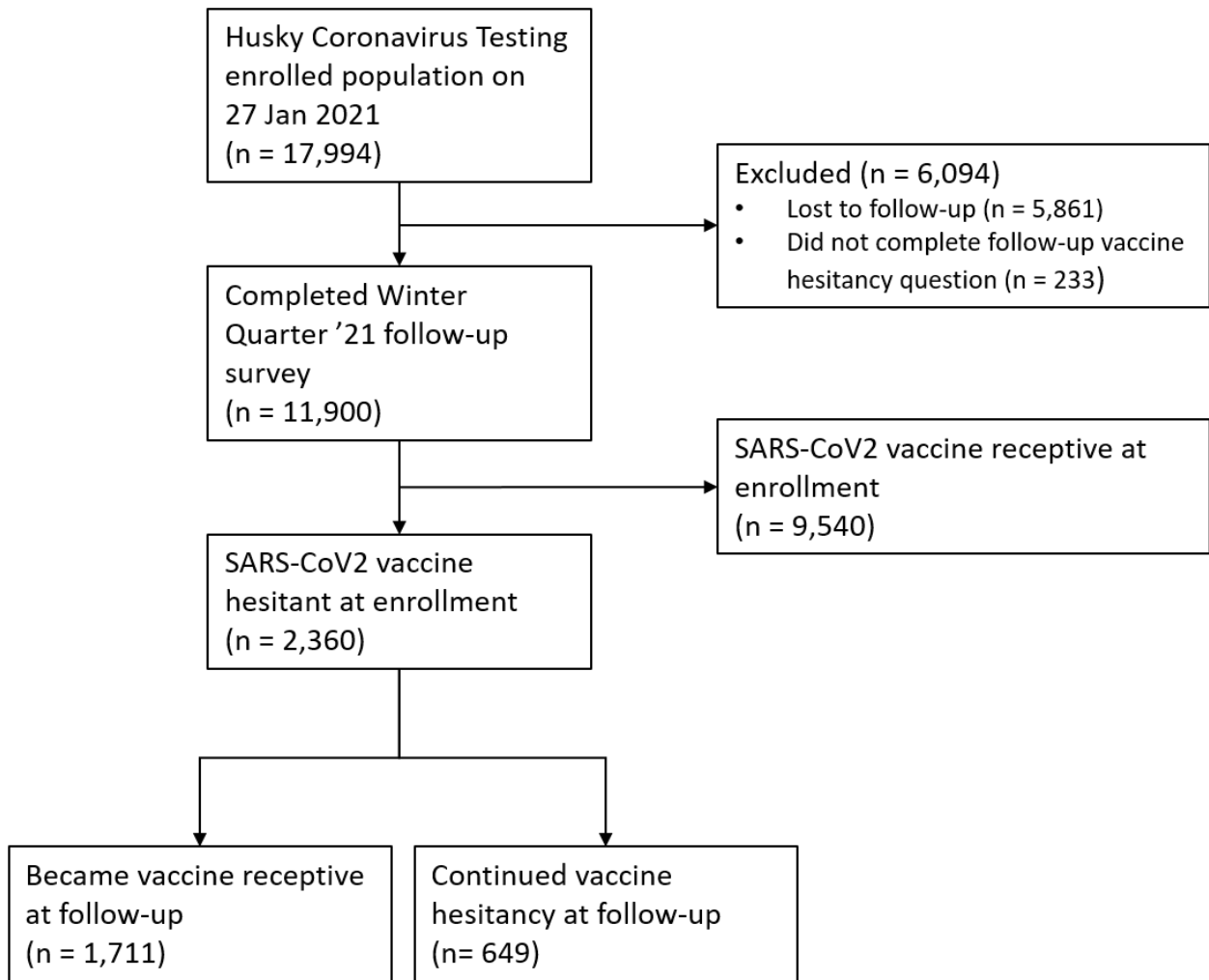


Table 2: Prevalence and correlates of continued vaccine hesitancy among Husky Coronavirus Testing participants who were hesitant at baseline (n=2,360).

Prevalence Ratios of Continued Vaccine Hesitancy				
University of Washington HCT Participants at Follow-Up				
	N (%) ¹		Univariate	Adjusted
	Receptive	Hesitant	PR (95%CI) ²	PR (95%CI) ²
Population				
	1711 (72.5)	649 (27.5)		
University Affiliation³				
Student	924 (66.9)	457 (33.1)	Ref	Ref.
Staff	595 (77.7)	171 (22.3)	0.73 (0.62, 0.86)	0.95 (0.74, 1.21)
Faculty	175 (92.1)	15 (7.9)	0.26 (0.16, 0.43)	0.45 (0.25, 0.82)
Other	17 (73.9)	6 (26.1)	0.87 (0.44, 1.74)	1.12 (0.44, 2.87)
Age: years				
Median (IQR)	29.0 (21.0 to 43.0)	23.0 (19.0 to 34.0)	0.98 (0.98, 0.99)	1.00 (0.99, 1.01)
Sex assigned at birth				
Male	509 (71.1)	207 (28.9)	Ref	Ref.
Female	1194 (73.4)	433 (26.6)	0.94 (0.80, 1.09)	0.97 (0.83, 1.13)
Race				
White	1115 (79.1)	295 (20.9)	Ref	Ref.
Asian	294 (61.6)	183 (38.4)	1.76 (1.49, 2.08)	1.56 (1.31, 1.85)
American Indian or Alaska Native	12 (80.0)	3 (20.0)	1.02 (0.37, 2.83)	0.85 (0.31, 2.29)
Black or African American	48 (51.1)	46 (48.9)	2.36 (1.84, 3.02)	1.97 (1.52, 2.54)
Native Hawaiian or other Pacific Islander	9 (60.0)	6 (40.0)	2.05 (1.09, 3.84)	1.77 (0.96, 3.27)
Multiple Races	125 (68.3)	58 (31.7)	1.52 (1.18, 1.96)	1.21 (0.94, 1.58)
Other	69 (74.2)	24 (25.8)	1.29 (0.89, 1.87)	1.03 (0.67, 1.58)
Hispanic/Latinx Ethnicity				
No	1561 (72.9)	580 (27.1)	Ref	Ref.
Yes	134 (72.0)	52 (28.0)	1.03 (0.80, 1.34)	1.05 (0.75, 1.47)
Housing⁴				
Off-Campus Housing	1467 (74.2)	511 (25.8)	Ref	Ref.
On-Campus Housing	127 (59.6)	86 (40.4)	1.46 (1.19, 1.81)	1.22 (0.96, 1.54)
Greek (Chapter House and Live Out)	110 (68.8)	50 (31.2)	1.23 (0.95, 1.59)	1.32 (0.99, 1.78)

Prevalence Ratios of Continued Vaccine Hesitancy

University of Washington HCT Participants at Follow-Up

	N (%) ¹		Univariate	Adjusted
	Receptive	Hesitant	PR (95%CI) ²	PR (95%CI) ²
Shelter, transitional housing, or other	7 (77.8)	2 (22.2)	0.52 (0.08, 3.25)	0.49 (0.10, 2.40)
Campus				
Main Campus	1585 (73.5)	572 (26.5)	Ref	Ref.
Satellite Campus A	43 (57.3)	32 (42.7)	1.68 (1.27, 2.24)	1.23 (0.89, 1.69)
Satellite Campus B	83 (64.8)	45 (35.2)	1.31 (1.00, 1.72)	0.98 (0.72, 1.35)
Household or parent's income (if student)				
Less than \$25k	147 (63.1)	86 (36.9)	Ref	Ref.
\$26k-\$50k	223 (69.7)	97 (30.3)	0.81 (0.62, 1.04)	0.99 (0.77, 1.29)
\$51k-\$75k	222 (73.0)	82 (27.0)	0.73 (0.56, 0.96)	0.92 (0.69, 1.24)
\$76k-\$100k	160 (72.7)	60 (27.3)	0.74 (0.56, 1.00)	0.92 (0.68, 1.25)
\$101k-\$125k	163 (80.7)	39 (19.3)	0.52 (0.36, 0.73)	0.67 (0.46, 0.96)
\$126k-\$150k	117 (79.1)	31 (20.9)	0.58 (0.40, 0.84)	0.84 (0.58, 1.22)
More than \$150k	355 (85.3)	61 (14.7)	0.38 (0.28, 0.52)	0.55 (0.40, 0.76)
Don't know/Don't say	324 (62.7)	193 (37.3)	1.01 (0.81, 1.25)	1.00 (0.79, 1.27)
Received last year's influenza vaccine?				
Yes	1226 (79.3)	321 (20.7)	Ref	Ref.
No	485 (59.7)	328 (40.3)	1.99 (1.73, 2.28)	1.73 (1.49, 2.01)
Respondent currently living in Seattle?⁵				
Zip code in Seattle	1366 (74.6)	465 (25.4)	Ref	Ref.
Zip code not in Seattle	341 (65.0)	184 (35.0)	1.43 (1.24, 1.67)	1.52 (1.27, 1.84)
Comorbidity at baseline (non-allergy)?⁶				
No	1374 (71.3)	553 (28.7)	Ref	Ref.
Yes	324 (78.5)	89 (21.5)	0.79 (0.65, 0.97)	0.91 (0.74, 1.12)
Attained undergraduate degree?				
Yes	1028 (79.3)	269 (20.7)	Ref	Ref.
No	671 (64.6)	367 (35.4)	1.62 (1.41, 1.87)	1.19 (0.99, 1.44)
Reason for SARS-CoV2 vaccine hesitancy⁷				
Safety or information reasons	1559 (73.5)	563 (26.5)	Ref	Ref.
Non-safety or information reason	131 (67.9)	62 (32.1)	1.06 (0.81, 1.38)	1.05 (0.81, 1.37)

Prevalence Ratios of Continued Vaccine Hesitancy

University of Washington HCT Participants at Follow-Up

	N (%) ¹		Univariate	Adjusted
	Receptive	Hesitant	PR (95%CI) ²	PR (95%CI) ²
Don't say	21 (46.7)	24 (53.3)	1.96 (1.41, 2.73)	1.58 (1.04, 2.41)

¹To the follow-up survey question: "When the COVID-19 vaccine becomes available for you, do you plan to get vaccinated?" Receptive = "Yes" or "I have already received one/two dose(s) of the vaccine". Hesitant = "No" or "Undecided". ²Generalized estimating equations, working independence, robust standard errors. ³Those in the 'Other' affiliation category included postdoctoral fellows, externs, volunteers, and other university affiliates. ⁴A Greek 'Live Out' is a private house or apartment that is shared by members of the same Greek chapter. On-campus housing was defined as dormitories, apartments, and family units. ⁵Includes only Seattle city proper, not metro area. ⁶Allergy question was not specific to seasonal or vaccine allergy. ⁷Non-safety = "I am not worried about getting sick with COVID-19", "Want to make sure high-risk individuals get it first", "Do not have time to get vaccinated", "None of the above". Safety = "Concerns with newness of vaccine or rigor of vaccine testing", "Concerns about vaccine safety or effectiveness", "I need more information about the vaccine". Don't say = "Prefer not to say".

6 Appendix

6.1 Risk Tiers

Tier 1 (n = 7,444)

- Students living in on-campus housing (dorms/residence).
- Student affiliated with Greek life.
- Participants living with 4+ housemates.

Tier 2 (n = 3,496)

- Students on-campus 2+ times per week and living 3+ housemates.
- Faculty, staff, volunteers on campus 2+ times per week.

Tier 3 (n = 7,054)

- All others.

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