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Original Research

Low uptake of COVID-19 lateral flow testing among university students: a mixed methods evaluation

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ABSTRACT

Objective: This study aimed to evaluate COVID-19 lateral flow testing (LFT) among asymptomatic university students.
Study design: This study was a mixed methods evaluation of LFT among University of Bristol students.
Methods: We conducted (1) an analysis of testing uptake and exploration of demographic variations in uptake using logistic regression; (2) an online student survey about views on university testing; and (3) qualitative interviews to explore participants' experiences of testing and subsequent behaviour, analysed using a thematic approach.
Results: A total of 12,391 LFTs were conducted on 8025 of 36,054 (22.3%) students. Only one in 10 students had the recommended two tests. There were striking demographic disparities in uptake with those from ethnic minority groups having lower uptake (e.g. 3% of Chinese students were tested vs 30.7% of White students) and variations by level and year of study (ranging from 5.3% to 33.7%), place of residence (29.0%–35.6%) and faculty (15.2%–32.8%). Differences persisted in multivariable analyses. A total of 436 students completed the online survey, and 20 in-depth interviews were conducted. Barriers to engagement with testing included a lack of awareness, knowledge and understanding, and concerns about the accuracy and safety. Students understood the limitations of LFTs but requested further information about test accuracy. Tests were used to inform behavioural decisions, often in combination with other information, such as the potential for exposure to the virus and perceptions of vulnerability.
Conclusions: The low uptake of testing brings into question the role of mass LFT in university settings. Innovative strategies may be needed to increase LFT uptake among students.

Introduction

Lateral flow testing (LFT) of asymptomatic people remains an integral part of the UK's COVID-19 response. Since 9 April 2021, everyone in England has been eligible to take an LFT twice weekly.[1–4] There is an ongoing and polarised debate around mass testing to detect asymptomatic infections using this technology. As approximately one-third of people infected with SARS-CoV-2 have no symptoms, it is argued that identifying infections among this group so that they can isolate and their contacts be traced is key to controlling the pandemic.[3,4] Although this policy was well received by some,[5–7] others have raised concerns, particularly around test accuracy and the potential consequences of inaccurate results.[8–11] Although the accuracy of LFT is important, much less attention has been paid to the levels of uptake of testing, which could pose a major barrier for the use and effectiveness of asymptomatic testing.

In Autumn 2020, COVID cases were high among university students in the United Kingdom.[12] In November 2020, the government recommended LFT for university students, recommending that all students should have two negative tests before travelling home for the winter break.[1,13] In line with these recommendations, the University of Bristol announced that free LFT would be available for all students between 30 November and 18 December. During

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this period, students were able to book an appointment online and receive an LFT at one of two testing sites within the University. Students were offered two tests and were encouraged to leave 3 days between the first and the second test. The testing procedure was undertaken by the students themselves, but full instructions and support were available. The results were sent to the student by text and email approximately 30 min after their appointment. Evaluation of this testing strategy, including equity in testing uptake, is crucial if testing continues to be used to control the pandemic in the future.

University populations offer a unique opportunity to quantify testing uptake in a well-defined group of individuals. Our study aims to (1) assess uptake of LFT among University of Bristol students, including demographic variations, (2) explore the acceptability and feasibility of asymptomatic testing, and (3) explore the barriers and facilitators to uptake and effective implementation of testing.

Methods

We conducted a mixed methods evaluation of LFT among University of Bristol students who did not have COVID-19 symptoms, comprising a quantitative analysis of testing uptake data, a student survey and qualitative interviews.

Quantitative analysis

We analysed data on the uptake of LFT from 30 November to 18 December 2020. Students prebooked their tests online. On arrival at testing venues, they were asked to swipe their university identity card. A list of all students enrolled at the university, held by student records, was matched with the date of any tests undertaken, as collected via card swipes at testing venues using student ID number. Information held by student records included student's demographic data, level and year of study, faculty and place of residence (whether in halls or not). Testing uptake percentages were calculated among all students enrolled at the university. Information on location of students during the study period was not available. However, a sensitivity analysis was conducted by excluding students who were either enrolled on a distance learning course or completed a 'location of study' form, indicating that they were likely not going to be on campus. The total number of positive results was recorded at testing sites but was not documented for individual students. Univariable and multivariable analyses were conducted using logistic regression to explore demographic factors associated with being tested. All explanatory variables were included in the multivariable model *a priori*. Analyses were conducted in STATA 16.1 (StataCorp LLC, College Station, TX).

Survey

Participants were invited to complete a confidential online survey about their views of university testing (Supplement 1). A link to the survey was shared by the university communications team via social media (Facebook, Twitter and Instagram) and to all students enrolled at the University via the student newsletter. Informed consent was obtained.

Frequencies and descriptive statistics are presented for closed survey questions. Free text answers were used to offer further insight into answers given to closed survey questions. We identified key barriers to engagement with testing using qualitative content analysis in three stages[14–16] – survey responses were coded independently by two authors, codes were then categorised into a list of barriers and facilitators, and data assigned to each category.

Interviews

Volunteers who took part in the survey and provided consent to be contacted by the research team were invited to take part in an online interview. Participants were aged >18 years and a registered student at the university. We purposely sampled for diversity in key factors, including ethnicity, living arrangements, enrolled course, and whether or not they had taken a test at the university. Sample size was informed by the concept of 'information power',[17] with continuous assessment of the data in relation to study objectives.

Potential participants were provided with a study information sheet and given an opportunity to ask questions, informed of the voluntary nature of the study, and assured of the confidentiality of their data. All interviews were conducted via the telephone or online, and audio recorded verbal consent was obtained.

The semistructured topic guide (Supplement 2) aimed to explore participants' views about testing, understanding and interpretation of test results and impact on behaviour.

Data from interviews were analysed using a thematic approach.[18,19] Two researchers independently read and assigned codes to transcripts. Possible themes were identified and refined. Charts were developed for each theme, and relevant text from transcripts was copied verbatim. Charts were then used to compare data within and between individuals.

Results

Testing uptake

A total of 12,391 LFD tests were conducted on 8025 (22.3%) of the 36,054 students enrolled at the university. Of those tested, 3921 (48.9%) had one test, 3880 (48.3%) had the recommended two tests, 189 (2.4%) had three tests and 35 (0.4%) had four to six tests. There were 13 positive results.

Demographic variations in testing uptake (Tables 1 and 2)

Although the absolute percentage of students taking up testing was similar across genders (21.9% for men and 22.5% for women), women were more likely to be tested than men (adjusted odds ratio [aOR]: 1.18, 95% confidence interval [CI]: 1.11–1.25). There were striking variations in uptake by ethnic group. Uptake was highest in ethnically White students, with 30.7% taking at least one test. Uptake was lower among all other groups – it was lowest among students belonging to the Chinese ethnic group (3%, aOR: 0.17, 95% CI: 0.14–0.20), followed by the Black African, Black Caribbean and Black other group (12.3%, aOR: 0.34, 95% CI: 0.28–0.42). It was also low among the Indian, Pakistani and Bangladeshi groups (17.5%, aOR: 0.53, 95% CI: 0.47–0.61).

When compared with Year 1 undergraduate students living in halls of residence, Year 1 undergraduate students not living in halls were less likely to be tested (aOR: 0.20, 95% CI:0.17–0.24), as were postgraduate students, particularly postgraduate taught students (aOR: 0.15, 95% CI:0.14–0.17). Testing uptake also varied by faculty. Compared with students in the Faculty of Science, uptake was lower among those in all other faculties. It was lowest in the Faculty of Social Sciences and Law and the Faculty of Arts.

A sensitivity multivariable analysis excluding students who were likely not to have been on campus during the testing period ($n = 4907$, 13.6% of all students) did not alter the observed patterns

Table 1
Demographic characteristics of students according to uptake of testing ($n = 36,054$).

Characteristic	Not tested		Tested		Total
	n	%	*n*	%	*n*
Gender					
Male	12,430	78.1	3489	21.9	15,919
Female	15,557	77.5	4526	22.5	20,083
Other	40	80.0	10	20.0	50
Ethnic group					
White	14,675	69.3	6508	30.7	21,183
Indian, Pakistani, Bangladeshi	1423	82.5	301	17.5	1724
Black African, Black Caribbean, Black other	742	87.7	104	12.3	846
Chinese	5543	97.0	172	3.0	5715
Mixed	1220	72.2	470	27.8	1690
Other	1464	86.9	220	13.1	1684
Not reported	2962	92.2	250	7.8	3212
Level of study					
Undergraduate	15,700	69.3	6960	30.7	22,660
Postgraduate – research	3645	86.4	575	13.6	4220
Postgraduate – taught	8684	94.7	490	5.3	9174
Year of study[a]					
Year 1[b]	5898	72.6	2225	27.4	8123
Year 2	4384	68.4	2025	31.6	6409
Year 3	3873	66.8	1926	33.2	5799
Year 4+	1545	66.3	784	33.7	2329
Place of residence[a]					
In halls	3779	64.4	2093	35.6	5872
Not in halls	11,921	71.0	4867	29.0	16,788
Faculty					
Faculty of Science	2945	67.2	1438	32.8	4383
Faculty of Arts	4833	74.1	1694	26.0	6527
Faculty of Engineering	4267	81.6	960	18.4	5227
Faculty of Health Sciences	3232	75.1	1072	24.9	4304
Faculty of Life Sciences	2712	71.8	1065	28.2	3777
Faculty of Social Science and Law	10,039	84.8	1796	15.2	11,835

[a] Restricted to undergraduate students only.
[b] Includes 153 presessional students.

Table 2
Univariable and multivariable logistic regression analyses of demographic characteristics associated with testing uptake.

Characteristic	Univariable analysis			Multivariable analysis ($n = 36,051$)		
	Odds ratio[a]	95% CI	*P* value	Adjusted odds ratio[a]	95% CI	*P* value
Gender						
Male	Reference			Reference		
Female	1.04	0.99–1.09	0.161	1.18	1.11–1.25	<0.001
Other	0.89	0.44–1.78	0.744	1.42	0.67–3.02	0.360
Ethnic group						
White	Reference			Reference		
Indian, Pakistani, Bangladeshi	0.48	0.42–0.54	<0.001	0.53	0.47–0.61	<0.001
Black African, Black Caribbean, Black other	0.32	0.26–0.39	<0.001	0.34	0.28–0.42	<0.001
Chinese	0.07	0.06–0.08	<0.001	0.17	0.14–0.20	<0.001
Mixed	0.87	0.78–0.97	0.012	0.84	0.75–0.95	0.004
Other	0.34	0.29–0.39	<0.001	0.44	0.38–0.51	<0.001
Not reported	0.19	0.17–0.22	<0.001	0.20	0.17–0.22	<0.001
Student group						
Undergraduate – Year 1[b] – In halls	Reference			Reference		
Undergraduate – Year 1[b] – Not in halls	0.13	0.11–0.15	<0.001	0.20	0.17–0.24	<0.001
Undergraduate – Year 2	0.82	0.76–0.88	<0.001	0.85	0.79–0.92	<0.001
Undergraduate – Year 3	0.88	0.82–0.95	0.001	0.88	0.81–0.95	0.001
Undergraduate – Year 4+	0.90	0.81–1.00	0.042	0.85	0.76–0.95	0.004
Postgraduate - Research	0.28	0.25–0.31	<0.001	0.28	0.25–0.31	<0.001
Postgraduate – Taught	0.10	0.09–0.11	<0.001	0.15	0.14–0.17	<0.001
Faculty						
Faculty of Science	Reference			Reference		
Faculty of Arts	0.72	0.66–0.78	<0.001	0.64	0.59–0.70	<0.001
Faculty of Engineering	0.46	0.42–0.51	<0.001	0.70	0.63–0.77	<0.001
Faculty of Health Sciences	0.68	0.62–0.75	<0.001	0.67	0.61–0.75	<0.001
Faculty of Life Sciences	0.80	0.73–0.88	<0.001	0.75	0.68–0.83	<0.001
Faculty of Social Sciences and Law	0.37	0.34–0.40	<0.001	0.63	0.58–0.69	<0.001

CI, confidence interval.
[a] An odds ratio of <1 indicates lower uptake of testing compared with the reference group.
[b] Includes 153 presessional students.

in testing uptake. Odds ratios changed a little (all <10%) and were within the confidence intervals reported in Table 2.

Survey

A total of 436 students completed the survey, of which 328 (75%) had taken part in testing and 108 (25%) had not (Supplement 3).

Attitudes towards testing

Among students who engaged in the university testing service and those who did not, the majority described their views of getting regular tests as either somewhat positive (31% and 31%, respectively) or very positive (51% vs 31%). Few participants described their views of testing as somewhat negative or very negative (18% of those who did not participate in testing vs 5% of those who did: Table 3).

Interpretation of test results

Most students understood that a negative test result meant that the person is probably not infectious (84% of those who had a test vs 75% of those who did not – Table 3). Only a minority of students in both groups thought a negative test means the person is definitely not infectious (6% of those engaging in testing vs 12% of those who did not) or that they did not know (4% of those engaging in testing vs 9% of those who did not).

Behaviour

Approximately half of the students engaging in testing reported that the level of contact with others had not changed in the seven days after the testing period (55%). Nineteen percent of students reported that close contact increased, and 17% reported that close contact had decreased following tests (Table 3).

Self-reported adherence to the guidance was similar between the groups, with 90% of those engaging in testing and 81% of those not engaging in testing reporting that they had been adherent to the guidance all or most of the time (Table 3).

Barriers

A total of 108 comments were coded and used to identify barriers to engagement in testing (Table 4). Barriers were categorised as (1) perceived lack of need or demand, (2) problems accessing the service, (3) safety concerns, (4) knowledge and understanding, and (5) lack of support for self-isolation.

Interviews

Twenty-one students were interviewed, including 14 who reported that they had taken a test at the university in December 2020 and seven who had not. Of the 14 students who had been tested, two had received one test and 12 had received two or more tests. Fifteen participants were women, and six participants were men. Eight participants were from minority ethnic groups. Six participants were postgraduate students, five were in Year 1, six were in Year 2, three were in Year 3, and one participant was in Year 4.

Data are presented under three main themes: (1) motives for engaging in testing, (2) barriers to testing, (3) and using test results to inform behavioural decisions.

Motives for engaging in testing

Three main motives for taking part in university testing procedures included (1) to reduce the risk of transmitting the virus, (2) for information and (3) following recommendations and guidance.

To reduce the risk of transmission to others

Most students were more concerned about the risk to others than to themselves (Table 5 quote 1) and were willing to take tests to protect other people from the virus. Tests provided reassurance that they were not spreading the virus to others (quote 2). This was particularly important for those planning to relocate for the holidays (quote 3), those with vulnerable family members (quote 4) or those who considered themselves to have been at risk of exposure to the virus (quote 5).

Table 3
Responses to survey questions.

Survey question	Participated in testing, N = 328	Did not participate in testing, N = 108
Views on getting tested regularly		
Very negative	2 (1%)	5 (5%)
Somewhat negative	14 (4%)	14 (13%)
Neither positive or negative	31 (9%)	16 (14%)
Somewhat positive	103 (31%)	39 (31%)
Very positive	169 (51%)	33 (31%)
Interpretation of negative test results		
The person is definitely infectious	6 (2%)	1 (1%)
The person is probably infectious	11 (3%)	3 (3%)
The person is probably not infectious	277 (84%)	81 (75%)
The person is definitely not infectious	21 (6%)	13 (12%)
Don't know	13 (4%)	10 (9%)
Close contact following test		
Much more contact	12 (4%)	NA
Slightly more contact	49 (15%)	NA
About the same	180 (55%)	NA
Slightly less	22 (7%)	NA
Much less	35 (10%)	NA
Missing	30 (%)	NA
Adherence to social distancing recommendations		
All of the time	139 (42%)	41 (38%)
Most of the time	156 (48%)	47 (43%)
Some of the time	19 (6%)	7 (6%)
Not at all	1 (0%)	5 (5%)
Missing	13 (4%)	8 (7%)

Table 4
Coded survey responses relating to barriers and facilitators to testing.

Theme	Description	Example quote	Count
Perceived lack of need/demand			
Lack of exposure/self-isolating	Includes comments about not requiring tests due to not being exposed to the virus (e.g. as a result of students self-isolating).	*"I had already been isolating (by choice) for two weeks, so that I was able to go home."*	6
Lack of travel plans	Includes comments by participants who are not intending to leave Bristol.	*"As I had no plans to go home over Christmas I didn't go for a test."*	11
(Low) priority	Captures comments by participants who do not think COVID is a threat.	*"Completely unnecessary, cancer has a higher chance of death but I don't get tested for cancer."*	1
Students not in Bristol	Many students were not in Bristol at the time of testing.	*"I had already returned home for lockdown before tests were available."*	13
Previously tested positive	Comments about tests not being necessary due to having previously tested positive.	*"I have already had the virus so would not be expected to contract it again."*	9
Accessing the service			
Location	Includes comments about testing sites being inaccessible to those who live off campus, are based at a different campus (e.g. Langford) and/or who are new to the University and not familiar with the layout.	*"Test site are too far away for many students in private housing."*	12
Timing of testing	Includes comments relating to a too narrow testing window for some students – in particular international students, those on placement, and/or those with jobs were not able to travel within the window specified.	*"I was travelling after the student travel window as I'm an EU student, and the student travel window was very inconvenient. The testing during the travel window was stopped before I needed to get a test in coordination with my travel plans, as the University testing was too early for me so wouldn't have been helpful."*	5
Inaccessible to key groups	Includes comments about testing facilities being inaccessible to those with additional needs and/or with caring responsibilities.	*"Current testing facilities and practice fail the disabled population."*	2
Booking issues	Includes comments about students being unable to use the booking system and/or book tests.	*"Tried to book a slot on website and it was not easy so I gave up."*	5
Safety concerns			
Risk of exposure at the testing site	Comments about concerns of risk of exposure whilst accessing tests.	*"After watching the virtual tour of the testing facilities (on Instagram), and also showing this to my family, it seemed the booths were all very close together in an enclosed space. This, combined with the high rates of Covid among the student population, made me feel that getting a test in these conditions would put me at greater risk of catching the virus."*	10
Accuracy of tests	Includes comments about tests not being suitable or accurate enough to facilitate safe travel. Also includes comments by students who had had a confirmatory PCR with conflicting result.	*"The lateral flow tests were advertised as a green card to go home safely without self isolating. It was made to seem like people who test negative are safe. I feel like I was misled because I was not aware that half of positive cases are missed and I felt like I had a false sense of security. Lateral flow tests literally say not for asymptomatic testing on the packaging."*	11
Knowledge and understanding			
Of testing	Including comments about a lack of/unclear instructions about how to take the test and/or number of tests needed.	*"I thought the testing instructions weren't clear enough for someone who isn't familiar with anatomy. "Swab your tonsils for 10 s" is only a useful instruction if you know where the tonsils actually are."*	5
Of eligibility	Includes comments in which participants explain that they did not take part in the testing program as they did not have symptoms/had previously tested positive and/or did not understand who testing was for.	"*I didn't know the testing facility was for even if you didn't have symptoms.*"	7
Impact of test results			
Lack of support for self-isolation	Includes concerns about the lack of support for those who test positive.	*"My other main concern is the lack of mental health support for those isolating and/or following all guidelines."*	2

For information

In some cases, students wanted to take tests for information (quote 6). Although these students were not necessarily planning to travel, they were keen to take tests for their own benefit (quote 7), including for their mental health (quote 8).

Following recommendations

Students reported taking tests simply because they were available (quote 9) and supported by the University (quote 10). For some, tests were a requirement for attendance at in-person lectures (quote 11) or travel (quote 12).

Barriers

Barriers to uptake of testing include (1) lack of need, (2) lack of awareness, (3) access, and (4) risk of exposure at the testing site.

Lack of need

One reason for not engaging in testing was that the student did not think that tests were required or intended for them. For example, one student explained that she had not taken a test at the university because she was not planning to travel away from Bristol (quote 13). In some cases, participants did not think tests were

Table 5
Key quotes from interview participants.

Motives for engaging in testing	
Reduce the risk of transmission to others	
Quote 1	"I'm most nervous about passing it on to somebody …. I know a lot of people live with parents or older people or just people on the street. Obviously I don't want to get it myself because that would not be fun but I'm more nervous about passing it onto someone … I'm more worried about hurting someone else." [female, Asian, tested]
Quote 2	"I think it's good for that reason to make sure that you're fine and you know that just going to the shops you're less likely to spread it to someone." [female, Asian, tested]
Quote 3	"Because I was going home, I guess I wanted to lower the chance of me bringing COVID home." [female, White, tested]
Quote 4	"The first time was when the government told us we could all go back home and I wanted to do two tests because if I did get positive and I had to stay here a bit longer, but I would really rather not bring the disease back to my family. Both my parents are a little bit older and my brother's girlfriend is in the vulnerable category." [female, White, tested]
Quote 5	"I had two tests before Christmas because I'm on a PGC programme so I've been in school up until Christmas, then I went to see my family at Christmas." [female, White, tested]
For information	
Quote 6	"I just thought one of the main issues is not knowing whether you have it or not. Information is important so it was an opportunity to get information." [male, White, tested]
Quote 7	"I just wanted to have an idea. I mean I've been pretty good with isolating. I hadn't really been around many people since the beginning of December but … I just wanted to double check, yes … I wanted it for me." [female, mixed ethnicity, tested]
Quote 8	"So I think it's really important just on a mental health level to get tested to make sure that you're not spreading it around. I was negative. I was just worrying for no reason." [female, Asian, tested]
Following recommendations	
Quote 9	"I think just the fact that it was there, so there was obviously the opportunity to [get tested]." [female, White, tested]
Quote 10	"I think I just thought it must be quite important for us to get tested if the University was offering them." [female, White, tested]
Quote 11	"I came back to university and the university asked us all to get tested before our first practical." [female, White, tested]
Quote 12	So in my country, they don't really care about Coronavirus, to put it simply but because my mum is a doctor, she expected me to get tested basically." [female, Asian, tested]
Barriers to the uptake of testing	
Perceived lack of need	
Quote 13	"I wasn't getting tested at university because it was people before they were going home. I stayed in [Bristol]." [female, mixed ethnicity, did not get tested]
Quote 14	"I wanted to go home for Christmas so I just isolated to make sure … most of my friends were also isolating and even if they weren't my dad's part of the vulnerable group so it just felt like the proper thing to do." [female, White, did not get tested]
Quote 15	"Most of the others just straight out went to get PCR tests 'cause they were also going back home' …" [female, mixed ethnicity, did not get tested]
Lack of awareness	
Quote 16	"To be honest I only became aware of it when I received an email asking me why people weren't – like or asking me why I thought students weren't taking up this offer. So I didn't even know it was there before." [female, mixed ethnicity, did not get tested]
Quote 17	"I don't know if I would have found that information out if I didn't have friends telling me that. I mean I know a lot of people in other places didn't get tested and I don't know if they even knew there was testing going on." [male, White, did not get tested]
Access	
Quote 18	"I couldn't get the links to work and they changed location and something else so it's that sort of booking process and also not knowing where it is that's prevented me from doing it this term." [male, White, did not get tested]
Quote 19	"To be honest, by the time I sort of got round to it and got like, you know, kind of – because you had to get two and one of them I think was clashing with when I was going back [home]." [female, Asian, did not get tested]
Quote 20	"I had one [test].. I left it too late to have them both." [female, White, tested]
Risk of exposure at the testing site	
Quote 21	"What if going to the test centre I come in contact with someone who is positive and I get it there?" [female, White, did not get tested]
Quote 22	"I think practically it was about half an hour walk to the nearest station and because I was already isolating it didn't seem that practical for me to go out and expose myself and then get tested." [female, White, did not get tested]
Quote 23	"I know cases are going up and I'd rather just be in my house where I know I'm safe." [female, White, did not get tested]
Using test results to inform behavioural decisions	
Quote 24	"The accuracy of the test is something that I've discussed quite a lot with friends so I was aware that they were not very good at picking up asymptomatic cases, so I feel like I kind of took the negative result with like a pinch of salt." [male, mixed ethnicity, tested]
Quote 25	"I just thought it was like an additional bit of information." [male, White, tested]
Quote 26	"We had this testing I was kind of confident that, well okay I already had those tests. Nobody had any symptoms so I thought, okay it might be okay." [female, Asian, tested]
Quote 27	"I think I was just much less worried about travelling home with COVID. I think I was able to travel home with a bit more sort of like okay, the chances are I probably don't have COVID right now, like I've done everything I can anyway." [male, White, tested]
Quote 28	"I mean I accept that there is a margin for error with anything really but I was willing to accept the results as sufficient, as good enough to make decisions on, like to make my decisions on." [female, White, tested]
Quote 29	"I mean I think it does reassure you doesn't it … it is reassuring because even though it's not very accurate, you still haven't tested positive, so it is a level of reassurance, but it's very, it should be less than what it is, but even though someone who like knows about it and understands, I was still reassured and I think it's hard not to be and I guess isn't that sort of the point of testing anyway." [male, White, tested]
Quote 30	"I definitely wouldn't be visiting anyone who was vulnerable. Everyone in the household I was going to are not in their 60s but I think late 50s max and healthy and young." [female, mixed ethnicity, tested]
Quote 31	

(*continued on next page*)

Table 5 (*continued*)

	Obviously I wouldn't say get tested and go to parties because that's ridiculous but going to the shops and going on a walk and just going to places that you have to be." [female, White, tested]
Quote 32 and 33	"but then I was very aware that if I went into the supermarket then I could just easily have gone and got infected again so it was like yeah for now but [laugh] 'cause the wording was like at the time you took your test, you tested negative but reinforces like this is very temporary assessment of your situation but it's still better than like having no idea'."
	"my confidence in [the negative test result] decreases with the more contacts I have with people or the more public places I got to or when I'm with people. My confidence decreases the more exposure I have to people." [female, Asian, tested]
Quote 34	"I'm sure for some that it would but I'm sure for most that it wouldn't and I think the people who would probably act differently following one of those negative tests would probably act like that anyway. So I don't think, for the good impact it would have I think the negative impact would be very small."[female, White, tested]

needed because they were not considered capable of achieving perceived needs (e.g. of keeping themselves and their families safe). Indeed, those who were able and willing to isolate often considered this preferable to testing (quote 14) or demonstrated a preference for polymerase chain reaction (PCR) tests over LFT (quote 15).

Lack of awareness

A lack of awareness prevented some students from accessing the service (quote 16). Students thought that more could be done to promote awareness of testing, particularly among those who do not have a strong network of peers (quote 17).

Access

A number of practical barriers were described, including access issues (quote 18) and issues with the timing and location of test sites (quote 19). At times, access issues resulted in students only being able to have one test before travelling (quote 20).

Risk of exposure at the testing site

Concerns of catching the virus at or on route to the testing centre prevented some students from taking a test (quote 21), particularly among those who had to travel long distances (quote 22). It was noted that cases of the virus were high among the student population, and some considered the risk of exposure to outweigh the benefits of getting tested (quote 23).

Using test results to inform behavioural decisions

Most students were very aware of the ongoing debate about the accuracy of LFTs and reported having discussions with their friends and families and, in some cases, with the university about how accurate the tests were (quote 24). Tests were considered just one piece of information from which to inform decisions (quote 25), often being used alongside other key indicators – such as whether the person had been in contact with someone with the virus or if they had any symptoms (quote 26). Some students reported that testing had reassured them that they had 'done everything they could' before travelling (quote 27). Despite limitations, tests were seen as 'good enough' to inform decisions (quote 28), and although students reported feeling somewhat reassured by negative test results (quote 29), they described being unlikely to drastically increase contact or to visit anyone considered to be vulnerable (quote 30). Activities were limited to those that were considered essential, such as shopping and exercise (quote 31), and it was recognised that any negative rest result was only 'valid' for a limited time, and any subsequent contact was a potential risk (quotes 32 and 33).

There was an acknowledgement that receiving a negative test could increase close contact behaviour, but generally, it was noted that students who were likely to break the rules would do so regardless of testing status (quote 34).

Discussion

Our research revealed that one in 10 students had the recommended two LFTs and highlighted demographic disparities in uptake by ethnic group, level of study and year group and faculty. Data collected from survey and interview participants suggested that whilst students were generally positive about testing, key barriers to uptake remain. Our qualitative data revealed that many participants were motivated to take tests to protect those around them and avoid transmitting the virus to their friends and family. However, students reported a number of barriers to uptake, including a lack of awareness of the testing service, problems accessing the service, a lack of knowledge and understanding of testing procedures and concerns about the accuracy and safety of testing. Although overall uptake was low, many of those who did not take tests described a lack of need for tests because they were not travelling, were unlikely to have been exposed to the virus, were already isolating or were tested elsewhere.

Mass testing for COVID-19 is relatively new, and the results of testing programmes are ongoing. Our data revealed low testing uptake, particularly among those from ethnic minority groups. Similar patterns in testing uptake have been observed with some other public health interventions such as home HIV testing.[20] The mass COVID-19 LFT pilot conducted in Liverpool also reported a lower test uptake, as well as a higher positivity rate, among those from minority ethnic groups.[21] The very small number of positive tests during the study period precluded analyses on demographic variations in positivity, both due to a lack of power and the potential for deductive disclosure. Further research is urgently needed to explore barriers to testing among these populations and co-create interventions to support the uptake of tests if and when required.

Consistent with findings from other settings[22] and other universities, students engaging in testing were motivated to do so to protect those around them.[22,23] In line with survey studies that have explored knowledge, attitudes and behaviours in relation to COVID-19,[22] awareness and access issues often prevented students from receiving tests. Through the present study, we have been able to build on previous work and present a detailed consideration of these and other barriers to uptake among student populations. In particular, participants in the present study were able to describe a perceived lack of need for testing either due to personal circumstances or because they did not think that tests were able to achieve their perceived need. This highlights the need for additional information about the role and benefits of taking LFTs before travel.

Despite concerns that testing would increase risky contact, we did not find evidence to support this. Students were well informed about the limitations of the tests and used them with caution to inform behavioural decisions. Students were well informed about the limitations of tests, often describing test results as just one piece of information, and using them with caution to inform their behaviour.[24] Many students had done their own research and had

discussions with their friends, family, tutors and lecturers to maximise their knowledge of testing. This highlights the need for improved communications from universities to enable students to make their own informed decisions. Indeed, recent research that has shown basic and simple messages may not be suitable for communicating complex information about how to behave during the pandemic,[25] and students are likely to appreciate having the opportunity to access information about the sensitivity and specificity of the tests.

A key strength of this research is the use of a mixed methods approach. Additionally, though some other universities have evaluated their LFT programmes[26,27] we are not aware of any reporting data on testing uptake and exploring demographic variations in uptake among the whole student body. This is a unique strength of our work and provides crucial information to inform future university testing strategies. Our work identified several ways in which engagement may be enhanced. In particular, we recommend a persuasive, targeted and personalised campaign. Such a campaign should include encouragement from trusted sources and emphasise the benefits of testing to encourage participation among those who may be apathetic. It would also need to reassure those who are anxious about accessing the testing services. To maximise engagement, all messages should be co-created with the intended recipients of campaign. A limitation of the analyses on testing uptake is that denominator was all students enrolled at the university. The university does not hold comprehensive and reliable information on which students were resident in Bristol during the testing period. However, in our sensitivity analysis in which excluded students who were likely not to be in Bristol at the time of testing, the findings were little altered. A key limitation of the survey and interview data is that participant recruitment occurred via social media, and it is likely key communities (e.g. those who do not engage with university managed social media accounts) were missed.

It should also be noted that most participants who took part in the interviews had received two tests as part of University testing. Only a small number of participants had not taken a test or had only taken one test. It is therefore likely that the participants recruited had more positive attitudes toward testing than those who did not take part in the interview, and the full range of barriers to uptake of both first and second tests may not have been identified. Our results must be interpreted with this in mind. Indeed, the fact that only a small number of participants had chosen not to take a test precludes our ability to explore relationships between demographic variables and barriers to uptake of tests. Although a key finding from the analysis of the uptake of LFT is that uptake was lower among minority ethnic students, there did not appear to be any relationship between barriers and demographic variables among the seven participants who did not have a test. However, as this is only based on seven participants, this must be interpreted with caution. In addition, it was not possible to explore the impact of demographic variables for the survey phase of the research, as there were only a very small number of comments coded as each barrier. Likewise, as only a small number of participants reported having increased contact, it was not possible to explore any impact of demographic variables on behaviour.

Conclusions

LFT continues to play an important and expanding role in the UK's COVID strategy.[3,4] If regular LFT is considered appropriate and worthwhile going forwards, then work is needed to monitor trends in testing uptake among student, and other, populations. Importantly, we need to strive for equity in access to and uptake of testing. Our findings should be used to inform the wider debate around the usefulness and appropriateness of the widespread use of LFT for asymptomatic people.

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Ethical approval

Ethical approval was provided by the University of Bristol – Ethical approval was obtained from the University of Bristol faculty ethics committee (Reference 115084). All interview participants verbally consented to take part in the study.

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Competing interests

None declared.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2022.01.002.

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