

BMJ Open Exploration of the uptake of asymptomatic COVID-19 lateral flow testing in Birmingham, UK: survey and qualitative research

Jonathan Mathers ¹, Christopher Poyner,¹ Dean Thompson,¹ Gavin Rudge,¹ Ruth V Pritchett²

To cite: Mathers J, Poyner C, Thompson D, *et al.* Exploration of the uptake of asymptomatic COVID-19 lateral flow testing in Birmingham, UK: survey and qualitative research. *BMJ Open* 2022;**12**:e056606. doi:10.1136/bmjopen-2021-056606

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2021-056606>).

Received 19 August 2021
Accepted 15 March 2022



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Institute of Applied Health Research, University of Birmingham, Birmingham, UK

²Institute of Applied Health Research, University of Birmingham, Edgbaston, UK

Correspondence to

Dr Jonathan Mathers;
j.m.mathers@bham.ac.uk

ABSTRACT

Aim To examine public perspectives on lateral flow testing (LFT) for COVID-19.

Design Online survey with nested semi-structured interviews.

Setting Birmingham, UK.

Participants 220 Birmingham residents, 21 of whom took part in an interview.

Results Fifty-six per cent of respondents had taken an LFT. Reasons for not testing included adherence to other government COVID-19 guidance, having had a vaccination and not thinking LFTs were accurate. In 16% of households with children nobody, including children, was testing. In households where children were testing, their parents or other adults were often not. Those who were testing and eligible for workplace and school testing were more likely to be testing twice weekly. In other settings, respondents were more likely to be testing on a one-off or ad hoc basis. Approximately half of respondents said that they were likely to visit friends and family after a negative test result and 10% that they were unlikely to self-isolate following a positive test result. In interviews, participants who were testing described the peace of mind that testing afforded them prior to activities or interactions with family and friends, including those they considered to be vulnerable. Interviewees who were not testing described concerns about test accuracy and also cited a lack of face-to-face interaction with others precluding the need to test. Participants were often testing flexibly according to circumstances and perceived risk of COVID-19 transmission.

Conclusions While some choose not to test, others are doing so in order to provide peace of mind to engage in personal interactions they might otherwise have avoided. This peace of mind may be a necessary pre-requisite for some to more fully re-engage in pre-pandemic activities. Despite clear concerns about test accuracy among those not testing, those who are testing held generally positive attitudes towards the continued use of LFTs.

INTRODUCTION

Lateral flow (LF) testing for asymptomatic cases of COVID-19 has become a mainstay of the UK Government's approach to the control of transmission during the current

Strengths and limitations of this study

- Contemporary survey and qualitative research exploring public perspectives and behaviour relating to lateral flow testing for COVID-19 in Birmingham, UK.
- Online survey and in-depth interviews illustrating diversity of views and behaviour.
- Relatively low response to survey and non-representative sample.

pandemic. Test kits are currently available for use at a population level, for example, via online ordering or accessed via community locations such as pharmacies.¹ Testing has been implemented in specific settings where risk of transmission is thought to be higher (eg, schools, universities, workplaces) and where individuals might be at particularly high risk of poorer outcomes should they become infected, such as prior to care home visits. Testing is increasingly being used to sanction activities, including social entertainment and travel.

Concerns regarding the scientific basis, appropriateness and utility of population-level screening using lateral flow tests (LFTs) have been raised, with questions about the likely effectiveness of testing to achieve transmission control, and the evidential basis for the UK government's approach.² The ethical basis for school testing approaches has been questioned,³ and a Cochrane review of rapid point-of-care tests for the diagnosis of COVID-19 stated that data to support the use of LFTs in asymptomatic populations is not yet available.⁴

Population-level LF testing approaches were first piloted in Liverpool, UK, in 2020.⁵ Subsequently, the accuracy of the test being used by the UK National Health Service, the INNOVA LFT, has been reported,^{6 7} with performance being markedly improved at

higher viral loads. However, there is continued debate regarding the basis for the reported estimates of test accuracy following an FDA notice advising against the use of the INNOVA LFT in the USA.^{8,9} As well as the evidential basis for the tests utilised in population screening, perceptions of testing and related behavioural responses, such as whether people test or not, are crucial components of screening programmes. The Liverpool pilot evaluation examined reasons for uptake of testing for COVID-19 and participants' behavioural intentions post testing.⁵ Other research has examined the usability and acceptability of LF testing at home, with a focus on individuals' experience of the test process itself rather than motivations for testing.¹⁰

The aim of this study was to further examine public perspectives on LF testing for COVID-19 at a time of national population-level screening and increasing rates of COVID-19 vaccination. The research explored reasons for uptake or refusal of testing in different settings; patterns of testing (frequency, who within households is testing); experience of the testing process; perceptions of test accuracy and behavioural intentions post testing. An online survey with a nested sample of follow-up semi-structured interviews with participants was undertaken in the City of Birmingham, UK.

METHODS

Study design

The study was an online survey with nested semi-structured interviews with a sample of survey respondents.

Sample

The online survey opened on 9 April 2021 and any resident aged 18 years or above in Birmingham, UK (defined as anybody resident within the Birmingham City Council catchment area) was eligible to participate. Participants were asked to provide the first part of their postcode to confirm eligibility. The survey was advertised online, via social and other media, and by poster at test sites in Birmingham. Survey participants gave informed consent and were asked to indicate if they would be willing to take part in a follow-up interview. A purposive sample of survey respondents were invited to interview based on their demographic characteristics and survey responses (eg, age, testing/not testing, setting for testing, perspectives on testing).

Survey content

The survey tool contained a mix of fixed (categorical and Likert scale) and free text response items (online supplemental appendix 1). It was organised according to setting for testing (walk-in/at home; school/household/bubble; workplace; university) and participants were asked to indicate which setting/s were relevant to them. Questions included details of test uptake/non-uptake; reasons for test uptake/non-uptake; frequency of testing; experience of the testing process; perceptions of test accuracy;

post-test result behavioural intentions; demographic data for respondents and indication of willingness to participate in a follow-up interview.

Interviews

Semi-structured interviews were conducted via telephone or video conferencing and were audio-recorded. Interview content was designed to provide further detailed exploration of interviewees' survey responses and the reasoning underpinning these (online supplemental appendix 2). Discussion of participants' views regarding testing to enable activities was also included.

Analysis

Survey data were analysed using simple descriptive statistics and content analysis for free text comments. Interview data were analysed thematically from interview recordings. CP and RVP undertook initial analyses, which were shared and discussed with the other authors. Initial analytical summaries were created for each interview, and an analytical matrix was established by cross-tabulating individual participant responses with key analytical questions, prior to summarising the data.

Patient and public involvement

The draft online survey tool was piloted among a small convenience sample of members of the public and other stakeholders including staff based at Birmingham City Council and local NHS Test and Trace. Question formulation and response categories were amended based on feedback. The research project was conceptualised following discussion with collaborators in Birmingham City Council and NHS Test and Trace.

RESULTS

There were 220 responses from Birmingham residents to the online survey, 21 of whom took part in a follow-up interview (table 1). Of those that provided demographic data the mean age of survey respondents was 45 years; 75% were female and 91% identified as white British. Of the interviewees, 18 were female, 13 were testing regularly, 2 had tested once only and 6 were not testing.

Key survey findings

Across all settings, 56% of respondents had taken a test and approximately half of respondents had tested via a walk-in facility or the home ordering service (table 2). The majority of respondents for whom university and workplace-based testing was relevant stated that they had already taken a test or intended to do so (table 3). Sixteen per cent of respondents in a household with children or part of a childcare support bubble stated that no one (including children) in the household or childcare support bubble was testing at home (table 4). For households comprising a child attending a secondary school or college, this figure was 10%.

For those individuals not testing via walk-in centres (n=188), the most frequently stated reasons were

Table 1 Interview sample characteristics

ID	Gender	Age (years)	Occupation	Testing	Test setting*	Children (none/primary/secondary/both)	Secondary school age children testing
1	Female	20–24	Student	Yes	University	None	n/a
2	Female	50–54	School support worker	Yes	Home/school	Secondary	Yes
3	Male	70–74	Retired	No	n/a	None	n/a
4	Female	50–54	Auditor	Yes	Care home	None	n/a
5	Female	35–39	PA	Yes	Walk-in and online	None	n/a
6	Female	75–79	Retired	Yes	Walk-in and online	None	n/a
7	Female	60–64	Care assistant	Yes	Home	None	n/a
8	Female	20–24	School support worker	Yes	Home	None	n/a
9	Female	45–49	Manager	No	n/a	Secondary	No
10	Female	Data not provided	Register nurse	Yes	Home/school	Secondary	Yes
11	Female	65–69	Teacher	Yes	Home	None	n/a
12	Female	50–54	University lecturer	Yes (once)	Walk-in	None	n/a
13	Female	50–54	Child-minder	Yes	Walk-in, online/school	Secondary	Yes
14	Female	35–39	Head teacher	Yes	Home	Primary	n/a
15	Female	35–39	Manager	No	n/a	Primary	n/a
16	Female	40–44	Centre manager	No	n/a	Primary	n/a
17	Female	45–49	Administrator	No	n/a	None	n/a
18	Female	55–59	Manager	No	n/a	None	n/a
19	Male	30–34	Assistant team manager	Yes	Walk-in	Primary	n/a
20	Male	40–44	Academic	Yes (once)	Walk-in/school	Secondary	Yes
21	Female	35–39	Office Manager	Yes	Home	Primary	n/a

*School=interviewee with secondary school age children who are testing regularly.

accessing LF testing elsewhere such as via schools and the workplace (n=57), personal adherence to other government guidance (n=46), having had a COVID-19 vaccination (n=21), not thinking that LFTs are accurate (n=28), perceiving the test to be painful or uncomfortable (n=16), and not having symptoms of COVID-19 (n=15).

Of those respondents who were testing, a greater proportion of those using home ordering, nursery, school, college or workplace testing was testing regularly

compared with respondents using walk-in or university testing (table 5). Of those testing regularly, more respondents in the workplace (94%), nursery, school or college (80%) and using home ordering (74%) stated that they were testing twice weekly than those using walk-in (45%) or university-based (27%) testing (table 6).

On the whole, survey respondents stated that test instructions were clear, testing was easy and results were very easy to understand (table 7). The majority of

Table 2 Test uptake

Test source	n (%)
Walk-in facility in Birmingham	59 (27)
Home ordering service in England	75 (34)
Neither	106 (48)
Total	220

Table 3 Test uptake/intention to test

	University, n (%)	Workplace, n (%)
Already taken test	34 (66)	67 (70)
Intend to take test	9 (17)	12 (12)
No intention to test	9 (17)	17 (18)
Total	52	96

Table 4 Test uptake/intention to test (in households with children in education)

Person taking test	n (%)
Respondent	9 (12)
Respondent/another adult	17 (22)
Respondent/another adult/children	15 (19)
Respondent/children	5 (6)
Another adult	4 (5)
Another adult/children	2 (3)
Children	13 (17)
None	12 (16)
Total	77

respondents (70%) stated that LFTs were somewhat accurate (table 8). Only 5% of respondents stated that tests were accurate.

When asked regarding post-test behaviours after negative test results, a high proportion of respondents indicated that they would be likely to maintain actions including hand washing, social distancing and wearing face coverings in enclosed spaces. Just over half of respondents stated that they were likely or very likely to visit friends and family following a negative result and 65% that they would go shopping. Following a positive test result, 10% of respondents stated that they were unlikely or highly unlikely to self-isolate and 90% that they would get a confirmatory PCR test.

Interview findings

Reasons for testing

Across all test settings, those who were testing predominantly described the peace of mind (regarding personal risk of transmission to others) that LF testing afforded. This was important when transitioning to settings where face-to-face interactions take place, such as from studying at home to studying on campus, going back to the office, or going to the shops:

Gives me peace of mind that I'm not going to spread it without symptoms... that other people in the office are testing and I can safely interact with them, and I know that if I go to the supermarket or see someone not in my household I know I'm not going to spread it to them as well. (ID 8, testing)

Some interviewees were conscious that they had close contacts who were worried about being infected or who

were shielding due to being clinically vulnerable. Therefore, testing was seen as a tool to ensure those closest to them also had peace of mind in their company:

I test to make sure I don't have COVID-19 before going home, my family are anxious about COVID-19 being brought back from campus. Having a negative helps them feel at ease. (ID 1, testing)

Those working in a setting where they had a duty of care for others, such as in adult social care or schools, were keen to emphasise how testing provided peace of mind regarding work-based interactions:

Because I work with children, I just want to make sure I'm not passing anything on really. (ID 11, testing)

Other workplace participants all described testing at least in part due to being asked to by their employer. However, participants on the whole appeared to feel their employers were justified in recommending LF testing. Across settings, the convenience of testing was also suggested to be key to uptake:

It's really convenient to get tested due to being on campus, I can see the testing site from my window. (ID 1, testing)

Participants largely found the testing process easy and quick since the roll out of home testing kits, and one participant contrasted this with their previous experience of travelling to a central location in Birmingham to get tested. Several interviewees anticipated using testing as government guidance is relaxed, to check they are 'COVID-19 free' before meeting friends and family:

The world's re-opening, we're seeing more people and I'm doing more tests at home.... I test before and after meet ups... if it gets us a normal life again I'm all for it [testing], I really am... I'd quite like to be able to make plans with friends without thinking right ok we can only meet outside and the weather's doing this so yeah I just want that bit more freedom. (ID 5, testing)

A small number of interviewees had secondary school age children. Parents reported face-to-face contact with grandparents as a key motivator for children to get tested, suggesting children missed their grandparents during periods of lockdown:

making sure that everyone was negatively tested as they should be, that was quite an incentive for our

Table 5 Test regularity

	Walk-in, n (%)	Home ordering, n (%)	Nursery/school/college, n (%)	University, n (%)	Workplace, n (%)
Regularly	20 (34)	53 (71)	39 (80)	12 (28)	66 (84)
Occasionally	23 (39)	12 (16)	9 (18)	25 (58)	12 (15)
Once	16 (27)	10 (13)	1 (2)	6 (14)	1 (1)
Total	59	75	49	43	79

Table 6 Test frequency

	Walk-in, n (%)	Home ordering, n (%)	Nursery/school/college, n (%)	University, n (%)	Workplace, n (%)
≥3 weekly	0 (0)	2 (4)	0 (0)	0 (0)	1 (1)
2 weekly	9 (45)	39 (73)	31 (79)	3 (27)	62 (94)
1 weekly	8 (40)	11 (21)	7 (18)	7 (64)	3 (5)
<1 weekly	3 (15)	1 (2)	1 (3)	1 (9)	0 (0)
Total	20	53	39	11	66

daughters to do it, like ok we get to see nanny. (ID 19, testing)

Due to testing, parents felt safer meeting more vulnerable relatives accompanied by their children. For example, one parent indicated their identity as a nurse was key in their children understanding the importance of testing:

As a nurse I've tried to impress onto them the importance of detecting what we can detect. (ID 10, testing)

Table 7 Experience of testing and reporting results

Clarity of instructions n (%)	Very clear	65 (87)
	Slightly clear	6 (8)
	Neither	1 (1)
	Slightly unclear	3 (4)
	Very unclear	0 (0)
Total		75
Difficulty of taking test n (%)	Very easy	45 (60)
	Slightly easy	13 (17)
	Neither	5 (7)
	Slightly difficult	9 (12)
	Very difficult	3 (4)
Total		75
Difficulty of understanding test results n (%)	Very easy	72 (96)
	Slightly easy	1 (1.3)
	Neither	1 (1.3)
	Slightly difficult	1 (1.3)
	Very difficult	0 (0)
Total		75
Difficulty of reporting results n (%)	Very easy	30 (53)
	Slightly easy	16 (28)
	Neither	3 (5)
	Slightly difficult	6 (11)
	Very difficult	2 (3)
	Total	57

Reasons for not testing

While some interviewees who were testing were also concerned about test accuracy, this was cited as a contributing factor to a decision not to test by others who were 'not convinced these LF ones are accurate' (ID 15, not testing). Some interviewees were concerned about self-isolation as a result of a false-positive result, something they felt was more common than a true positive:

The false positive rate is between 1/1000 and 3/1000 and people with COVID-19 is 1/600. If you work that out, that is more false positives than true positives. (ID 9, not testing)

While others were more concerned about the impact of false negatives and the 'green light' effect this may have on public behaviour:

I have concerns about tests... There's a high chance of false positives and negatives, not accurate enough. Not being used as intended. They're being used as a green light... There's a very low chance of picking up cases via LFTs and it's not worth the phenomenal cost... As the level of COVID-19 in the population drops the validity of mass testing drops as well. (ID 3, not testing)

Some interviewees felt safe from infection and therefore did not see the value in regular LF testing:

I'm not going out so not something that I've needed to have... if I haven't got symptoms and I'm not going anywhere, why do I need a test? (ID 17, not testing)

Other participants also suggested that low virus prevalence meant they were unlikely to contract COVID-19 and therefore did not need to test. Furthermore, some participants who had received one or two doses of a

Table 8 Perception of test accuracy

Accuracy	n (%)
Accurate	11 (5)
Somewhat accurate	153 (70)
Somewhat inaccurate	36 (16)
Inaccurate	15 (7)
Do not know	5 (2)
Total	220



COVID-19 vaccine were reluctant to use LFTs as they felt their chances of both catching and passing on COVID-19 were low:

If I hadn't had both of them [vaccinations] I probably would have had more lateral flow tests by now. (ID 12)

While not prevalent in the interview sample, one participant discussed 'selfishly' not wanting to engage in testing due to the amount of isolation their children had already faced during the pandemic and the impact this had on both their children's education and their ability to work from home:

From a selfish point of view, I didn't want to have to do them and then have to self-isolate because my daughter has missed so much school and I've missed so much work. (ID 15, not testing).

One participant was very anxious about the impact of self-isolation on their child due to an intellectual disability. This condition had been assessed as at risk of developing if isolated in their home:

My daughter has an intellectual disability that has been determined by a professional as being at risk of exacerbation by periods of isolation... Not a risk I'm prepared to take, I have to put my daughter first. (ID 9, not testing)

One parent discussed how the school suggested parents test, but then did not follow-up with provision of the correct amount of testing kits for whole households. They felt this acted as a disincentive to parent testing. They stated they have not heard from the school since about adult/parent testing:

Schools said it would be good if parents tested too but sent kits home for the kids but not the family. It's never been mentioned again by the school. (ID 20, tested once)

Some interviewees who had taken the decision not to take part in LF testing suggested that there was a strong feeling of social disapproval associated with this, with stigmatisation of individuals who took this decision:

This is where I get really worried about where we are going as a society, we haven't told anyone we are not testing, because I know they'll be backlash, so I feel I have to keep it a secret, even though I'm comfortable with my choice, and I know I'm acting in the best interests of my family... People would say I'm being very selfish, I think people actually believe that the testing is a way to stop transmission, and I'm not totally convinced... I feel that LFT may have a role in reducing transmission, but that comes at a cost and I feel it's not OK to discuss that cost. (ID 9, not testing)

Frequency of testing

Interviewees who reported testing varied in terms of testing frequency from twice per week to one-off usage. The majority reported testing twice weekly. Some participants stated that they were simply following government, school or workplace guidance, without understanding why twice-weekly testing is recommended:

Because that's what we were told to do [testing twice per week], that makes us sound like sheep, I know! I don't know the science behind it. (ID 2, testing)

Interviewees who were not testing regularly reported testing flexibly, according to circumstances, and perceived risk of transmission:

It might be once a week, it might be twice a week, it might be not at all, it's just based on how much I'm actually leaving the house. (ID 5, testing)

Perceptions of test accuracy and impact on behaviour

Regardless of reported testing behaviour, interviewees felt that LFTs could be inaccurate. Those who were testing tended to suggest that negative test results would not influence their behaviour due to possible false-negative test results:

The test is a guide, if negative it will not change my behaviour. Won't make me think yeah, yeah, I'm fine. I will still take precautions. I don't assume I'm negative; all test results have a degree of failure. (ID 2, testing)

Some who were not testing felt that the risk of a false-positive result was too high, citing the implications of such a result on their lives, and in some cases, society more broadly:

A false positive is not benign, they may send 100 kids home, on a false positive. (ID 9, not testing)

Those who were testing, however, felt LFTs were of value as 'not every test is going to be inaccurate' (ID 2) and therefore, due to some COVID-19 cases being picked up, it was still a worthwhile strategy:

I know that the LFTs aren't 100% but if it identifies one person whose got it who if they didn't know about it could've spread it then it's worthwhile isn't it (ID 4, testing)

Many interviewees reflected on the fact that LFTs were less accurate than PCR tests, both inherently and due to being self-administered. LFTs perceived lack of accuracy was discussed as having several ramifications. False negatives were felt to lead to a false sense of security which could increase risky behaviours and thereby 'aid the spread' (ID 3) of COVID-19. Even true negatives were seen to have a disadvantage in reducing caution:

It should be a red light system not a green light system... a negative shouldn't mean you're free to carry

on as normal but a red light could be useful (ID 3, not testing).

Equally, false positives were felt to be putting people in isolation on 'shaky data' (ID 3, not testing). Some interviewees were concerned about people taking LFTs when they had COVID-19 symptoms, then deciding not to get a PCR test or self-isolate as their LFT result was negative.

Experience of testing and reporting results

In concordance with the survey findings, the clarity of LFT instructions was generally discussed very favourably by interviewees. Overall tests were described as unpleasant, but this was seen as short lived and did not outweigh the peace of mind offered by testing:

Still makes me heave and eyes water, but the feeling passes quickly, and a small price to pay if COVID-19 infections are prevented by the testing strategy. (ID 2, testing)

Some parents described children having a very negative experience of the test, but again this did not necessarily deter them from further testing:

Children hate it, it's not a nice thing for them to do. I don't like doing it, but I just get on with it... I think it's the responsible thing to do. (ID 21, testing)

Most interviewees stated that they would report all test results, however, some would only report a positive test result and one discussed the possibility of not reporting a positive result due to concerns over test accuracy. Many described the NHS Test and Trace reporting system as adequate, however, some of those reporting results for someone else (often a child) found it frustrating having to upload the same details multiple times. Communication of positive test results through the contact tracing feature of the Test and Trace system was not always successful, with known contacts being informed personally by the individual but not through the Test and Trace system.

Post-test behaviour and self-isolation

When asked, most interviewees stated that a negative test result would not alter their social and personal behaviours relating to COVID-19 risk. However, some interviewees reflected how negative test results were subconsciously impacting on their comfort with certain behaviours:

In my head initially I want to say not...some behaviours have diminished...washing hands for as long? 'Maybe I'm more relaxed in some measures because I'm pretty sure none of us have got Coronavirus...not intentionally but that might be happening. (ID 19, testing)

When talking hypothetically about a positive LFT result, participants overwhelmingly stated a need to

get a confirmatory 'real (PCR) test' (ID 1) and self-isolate as 'you don't want to be responsible for other people's deaths' (ID 21). However, one interviewee felt the act of going to a test centre for a PCR test may carry an unacceptable risk of transmitting COVID-19.

The practical effects of self-isolation on work-life ranged from very little for those already working from home, to time off work with a guaranteed income, to loss of income for the self-employed. Psychological responses were equally varied, with one interviewee reporting that 'It would be hard to not leave the house for 10 days but it wouldn't be hugely different from what I do now' (ID 12), whereas another described how 'I would probably go into a panic [about the safety and running of the workplace].' (ID 14) One common struggle was the work-life balance of families isolating with children:

I would have to try and work with them here, and it's not fun and it's really hard. The school now would expect us to do home schooling, on top of working (ID 14, testing).

Overall, a common feeling was an awareness of the potential difficulties but a belief that they could be tolerated as a temporary, 'pretty minor inconvenience' (ID 20, tested once). However, delays due to family members succumbing to COVID-19 in succession were felt to be the 'nightmare scenario'. (ID 19, testing)

Views regarding societal use of LFTs

Societal impact

In broader terms, LFTs were seen to be useful in 'Enabling a bit more normality' (ID 13, testing), supporting confidence in forming bubbles, travel, social events, work, school attendance and wider societal opening. Several interviewees placed LFTs within the context of other elements in the country's response to COVID-19:

A useful tool along with other things—the masks, the vaccine, the social distancing. I don't think they're the be all and end all, I think they're just like part of that suite of precautions. (ID 4, testing)

vaccination is the great clincher but in the meantime LFTs will help people get their confidence back. (ID 6, testing)

One respondent particularly felt that LFTs 'Would have a role to play if a new variant increased prevalence' (ID 9, not testing)

Testing to attend events

The majority of participants responded favourably to the idea of 'test to do' as a policy approach, and most suggested they would be happy to test, if for example they were attending an event or travelling abroad:

It [test to do] doesn't bother me in the least...Yeah, yeah, it's protecting everybody. (ID 7, testing)

However, some practical concerns were raised. Some felt it was a very challenging policy to implement effectively.

For example, one interviewee suggested attendees could test themselves inappropriately or manipulate samples to ensure a negative test result:

Might be temptation to not do test properly, possible people would not adhere to social distancing guidelines, particularly youngsters (ID 10, testing)

Having to provide a negative LFT result in order to attend large social events was felt to be particularly hazardous, as false-negative results could lead to a possible outbreak.

Communication

You think there's been loads of communication (about LFTs) but it's actually quite easy as a citizen to miss it (ID 12, tested once).

Not all participants felt the communication around LF testing had been gauged correctly for them. Some who were less active on social media would have preferred physical adverts in shops where testing kits were available. One interviewee particularly disliked what he saw as the negative tone of government advice, instead of adverts that they saw as shaming people for not following guidance, they would have preferred a more positive, straightforward narrative informing people how to take a test and where to get one.

Some interviewees reported an 'impression not many people are doing them (LFTs)' (ID 19, not testing) perhaps due to the altruistic nature of testing.

Nobody's doing it to protect themselves, the protection is if you know someone else has a negative test, so there's no incentive for anyone to do it. (ID 6, testing)

DISCUSSION

Prior to this research, an exploration of UK public perspectives regarding population-level LF testing strategies was undertaken as part of Liverpool COVID-19 Community Testing Pilot.⁵ While many of the findings presented here resonate with the Liverpool findings, that evaluation was undertaken under very different circumstances as a pilot focused on a city with high rates of infection, during a national lockdown, and accompanied by mass media interest. The survey responses and interviews in this study provide further insight into reasons for test uptake, perceptions of LFT accuracy and post-test behavioural intentions as LFT strategies have been established at a national level at a later period in the pandemic and during a mass vaccination programme. This research was undertaken while UK government advice was to access twice-weekly LF testing for asymptomatic COVID-19, and specific testing guidance for schools and households with school age children had been implemented.

The survey and interviews demonstrate population awareness that LFTs do not have equivalent test accuracy properties to PCR testing. Other studies examining

perspectives on LFT accuracy also demonstrate that individuals give varied estimates of the accuracy of these tests¹¹ or express uncertainty about their accuracy.^{12 13} In a study of care home staff experiences of integrating LFTs in routine practice participants were worried about the implications of inaccurate results such as false positives.¹⁴ For some participants in our study, this was sufficient to influence decisions to not test, with concerns expressed in interviews regarding the individual and societal implications of false-positive and false-negative test results. However, others were not accessing LF testing as they perceived themselves to be at low risk of transmitting the virus to others, were following other government guidance at the time of the data collection (handwashing, social distancing, wearing of face coverings) or believed that having received one or two doses of a COVID-19 vaccination they were at lower risk of infection.

Those who were testing suggested in survey responses that negative test results would not influence behaviours such as social distancing and wearing of face coverings, similar to findings from research with university staff and students.¹¹ However, testing was seen as a way to afford individuals peace of mind when interacting with others, including family and friends and those perceived to be more vulnerable to the effects of COVID-19 infection. In the Liverpool pilot evaluation, 16% of respondents stated that they would also highlight the peace of mind given by testing if promoting testing to others, findings echoed elsewhere.^{11 12 15} In fixed survey responses in the Birmingham survey, more than half of participants stated that there were likely to see friends and family following a negative LFT result. Some interviewees who were testing or had tested were clear that despite knowledge that LFT accuracy was not perfect, they were using testing to 'green light' personal interactions. These findings differ from those of the Liverpool pilot scheme evaluation where only 4% of respondents to an Office for National Statistics (ONS) survey stated that they intended to carry out social activities following a negative test.⁵ In concordance with Blake and colleagues,^{12 16} our findings indicate that behavioural intentions may have shifted as restrictions have gradually been eased, as testing has been utilised to enable a range of activities and as the vaccination programme has progressed.

Furthermore, while survey respondents in school and workplace settings were more likely to report testing twice weekly according to government guidance, others reported testing on an occasional or ad hoc basis, associated with interactions outside of the immediate household. Elsewhere university students have given positive feedback about regular asymptomatic testing but also expressed a desire for reminders to do so.¹¹ In care homes, staff have been concerned about the additional impacts and stressors related to testing,¹⁴ and testing regimes were not well adhered to in a pilot scheme.¹⁷ In secondary school households, approximately 10% of respondents stated that nobody including school children were testing; 16% when including all school

households. Again, reports of perceived poor test accuracy were implicated in these decisions. In households where children were testing, some parents were not testing and others were testing on an ad hoc basis. There were several reports of negative experiences when trying to undertake home testing of children, particularly regarding the comfort of testing. There has been speculation that implausibly low positive test rates in children at school may be caused by poor swab technique.¹⁸ It is probable that this may be moderated by improving test comfort. However, a pilot of primary school testing in Germany found that while parents were concerned about additional burden children suggested that testing was less burdensome than other restrictions, such as mask mandates.¹⁵

While there was some scepticism about population-level LF testing strategies among some participants who cited a political rather than scientific basis for testing, others suggested that screening for cases of COVID-19 can only be a good thing. These interviewees were in favour of test-to-do strategies, such as to attend events. A small number of participants did suggest that they were not engaging in testing due to the perceived risk and negative consequences of self-isolation on educational, work or family life. We would estimate that this is likely to be more prevalent at population level as this was a key theme emerging from the Liverpool evaluation. Other research with university students shows some avoidance of testing due to fears of self-isolation requirements or causing others to have to self-isolate.^{16 19}

Limitations

Response to the survey was low, although the survey ran during a period of relatively low and falling rates of infection, hospitalisation and deaths,²⁰ and during the early stages of a vaccination programme. Furthermore, we know from these data that the vaccination programme was one reason for not taking an LFT, potentially limiting recruitment to the survey. The sample is not representative of the Birmingham population, being more predominantly female and of white ethnicity. Therefore, while the findings do illustrate diversity of views and behaviour in relation to LF testing, response bias is the main issue with online surveys. The views of men and respondents of non-white ethnicity are under-represented in this sample and may be somewhat different to those described here. There were a number of university-based respondents to the survey, which may have skewed some views regarding testing, for example, where respondents were more familiar with the emerging evidence related to test accuracy. We also struggled to recruit students to the interview portion of this research and were reliant on relatively rapid conduct and analysis of interviews within a short timescale. However, we were able to focus on core analytical questions and use a team-based approach to analysis and interpretation.

CONCLUSION

These data demonstrate that while some people are choosing not to undertake LF testing for asymptomatic COVID-19, others are doing so in order to provide the peace of mind needed to engage in personal interactions that they may otherwise avoid. This seems to be directly in tension with the initial justifications for population-level screening using LFTs. That is, their use as evaluated in the Liverpool pilot, to identify cases of COVID-19 and reduce transmission, without changing personal behaviours that might increase transmission risk. Indeed, there seems to have been a significant policy drift in the use of LFTs in order to sanction activities—travel, visits to vulnerable relatives, and more recently testing to reduce the length of the COVID-19 self-isolation period. Positive LFTs have also replaced confirmatory PCR tests for asymptomatic cases. The peace of mind described by participants in this research may well be a pre-requisite for people to more fully engage in activities they would otherwise be wary of. Many are engaging in LF testing and despite expressed concerns regarding test accuracy, those who are doing so hold generally positive attitudes towards their continued use.

Acknowledgements The authors would like to thank the study participants and also collaborators in Birmingham City Council and NHS Test and Trace who gave feedback on the survey design and facilitated survey distribution.

Contributors JM contributed to conception and design of research, creation of interview schedule, analysis, drafting of manuscript and findings, substantial revisions to manuscript and acts as guarantor for the research; CP contributed to conduct of interviews, qualitative analysis, quantitative analysis, drafting of findings, revisions to manuscript; DT to creation of online survey, quantitative analysis, qualitative analysis, drafting of findings, revisions to manuscript; GR to data analysis, critical appraisal of draft findings and manuscript; RVP to conduct of interviews, qualitative analysis, quantitative analysis, drafting of findings, revisions to manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by University of Birmingham Research Ethics Committee (ERN_21-0312).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iD

Jonathan Mathers <http://orcid.org/0000-0001-6651-6286>

REFERENCES

- 1 Order coronavirus (COVID-19) rapid lateral flow tests, 2021. Available: <https://www.gov.uk/order-coronavirus-rapid-lateral-flow-tests> [Accessed 18 Aug 21].
- 2 Deeks JJ, Raffle AE. Lateral flow tests cannot rule out SARS-CoV-2 infection. *BMJ* 2020;371:m4787.
- 3 Dinnes J, Davenport C. BMJ opinion, 2021. Available: <https://blogs.bmj.com/bmj/2021/03/16/do-we-have-informed-consent-for-asymptomatic-testing-in-schools/>
- 4 Dinnes J, Deeks JJ, Berhane S, *et al*. Rapid, point-of-care antigen and molecular-based tests for diagnosis of SARS-CoV-2 infection. *Cochrane Database Syst Rev* 2021;3:CD013705.
- 5 Liverpool TUo. Liverpool covid-SMART community testing pilot - evaluation report. 2021 17 June 2021.
- 6 García-Fiñana M, Hughes DM, Cheyne CP, *et al*. Performance of the Innova SARS-CoV-2 antigen rapid lateral flow test in the Liverpool asymptomatic testing pilot: population based cohort study. *BMJ* 2021;374:n1637.
- 7 Peto T, UK COVID-19 Lateral Flow Oversight Team. COVID-19: rapid antigen detection for SARS-CoV-2 by lateral flow assay: a national systematic evaluation of sensitivity and specificity for mass-testing. *EClinicalMedicine* 2021;36:100924.
- 8 Deeks JJ, Dinnes J, Davenport C, *et al*. Letter to the editor regarding Peto T; UK COVID-19 lateral flow oversight team: COVID-19: rapid antigen detection for SARS-CoV-2 by lateral flow assay. *EClinicalMedicine* 2021;38:101037.
- 9 LYW L, Tim TE. Letter to the editor in response to a letter by Deeks regarding Peto T; UK COVID-19 lateral flow oversight team: COVID-19: rapid antigen detection for SARS-CoV-2 by lateral flow assay. *Lancet* 2021.
- 10 Atchison C, Pristerà P, Cooper E, *et al*. Usability and acceptability of home-based self-testing for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) antibodies for population surveillance. *Clin Infect Dis* 2021;72:e384–93.
- 11 Wanat M, Logan M, Hirst JA, *et al*. Perceptions on undertaking regular asymptomatic self-testing for COVID-19 using lateral flow tests: a qualitative study of university students and staff. *BMJ Open* 2021;11:e053850.
- 12 Blake H, Corner J, Cirelli C, *et al*. Perceptions and experiences of the University of Nottingham pilot SARS-CoV-2 asymptomatic testing service: a mixed-methods study. *Int J Environ Res Public Health* 2020;18:188.
- 13 Hirst JA, Logan M, Fanshawe TR, *et al*. Feasibility and acceptability of community coronavirus disease 2019 testing strategies (FACTS) in a university setting. *Open Forum Infect Dis* 2021;8:ofab495.
- 14 Kierkegaard P, Micocci M, McLister A, *et al*. Implementing lateral flow devices in long-term care facilities: experiences from the Liverpool COVID-19 community testing pilot in care homes- a qualitative study. *BMC Health Serv Res* 2021;21:1153.
- 15 Wachinger J, Schirmer M, Täuber N, *et al*. Experiences with opt-in, at-home screening for SARS-CoV-2 at a primary school in Germany: an implementation study. *BMJ Paediatr Open* 2021;5:e001262.
- 16 Blake H, Knight H, Jia R, *et al*. Students' views towards Sars-Cov-2 mass asymptomatic testing, social distancing and self-isolation in a university setting during the COVID-19 pandemic: a qualitative study. *Int J Environ Res Public Health* 2021;18:4182.
- 17 Tulloch JSP, Micocci M, Buckle P, *et al*. Enhanced lateral flow testing strategies in care homes are associated with poor adherence and were insufficient to prevent COVID-19 outbreaks: results from a mixed methods implementation study. *Age Ageing* 2021;50:1868–75.
- 18 Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. *Lancet Infect Dis* 2020;20:533–4.
- 19 Knight H, Carlisle S, O'Connor M, *et al*. Impacts of the COVID-19 pandemic and Self-Isolation on students and staff in higher education: a qualitative study. *Int J Environ Res Public Health* 2021;18:10675.
- 20 Torjesen I. What do we know about lateral flow tests and mass testing in schools? *BMJ* 2021;372:n706.