COVID-19 Vaccine Hesitancy: A Midwifery Survey Into Attitudes Towards the COVID-19 Vaccine

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Abstract

Background: Ethnic minority populations have been disproportionately affected by the COVID-19 pandemic. Emerging evidence suggests a lower uptake of the vaccine in ethnic minority populations, particularly Black females of reproductive age. Midwives are the principal healthcare professionals responsible for counselling the pregnant population on decisions relating to vaccine uptake. The aim of this study was to explore midwifery uptake of and attitudes towards the COVID-19 vaccine in two ethnically diverse areas.

Methods: A 45-point questionnaire was circulated over a six-week period to midwives employed in two teaching hospitals in England; London (Barts Health NHS Trust) and Sussex (Brighton and Sussex University Hospitals NHS Trust (BSUH)). A total of 278 out of 868 midwives responded. Results were analysed to determine vaccine uptake as well as factors influencing vaccine hesitancy and decision-making between the two trusts and ethnic groups. Thematic analysis was also undertaken.

Results: Midwives of black ethnicity were over 4-times less likely to have received a COVID-19 vaccine compared to white ethnicity midwives (52% vs 85%, OR=0.22, p<0.001). Overall, there were no significant differences between trusts in receipt of the COVID-19 vaccine (p=0.13). Midwives at Barts Health were significantly more likely to have tested positive for COVID-19 compared to midwives at BSUH (OR=2.47, p=0.01). There was no statistical difference between ethnicities in testing positive for COVID-19 (p=0.86). Midwives at Barts Health had a higher occurrence of concerns relating to the vaccine being developed too fast (OR=2.06, p=0.01), allowing the government to track individuals (OR=9.13, p=0.001), interfering with fertility (OR=2.02, p=0.03), or transmitting the virus (OR=7.22, p=0.006), compared to BSUH. Black midwives had a higher occurrence of all concerns examined compared to white midwives; the most pronounced difference was in concerns relating to the long-term effects of the vaccine (adjusted OR=4.97, p<0.001), concerns relating to the speed in which the vaccine was developed (adjusted OR=5.59, p<0.001) and concerns regarding the vaccine containing meat products (adjusted OR=6.31, p<0.001).

Conclusion: This study highlights the significantly higher level of vaccine hesitancy amongst black ethnicity midwives and offer insights into midwives’ views and concerns to facilitate future targeted public health interventions for the COVID-19 pandemic.

Background

In late December 2019, the first case of a new viral disease called coronavirus disease 2019 (COVID-19), caused by the respiratory virus severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), was first reported in Wuhan City, China (1). SARS-CoV-2 is spread predominantly by the respiratory route and has led to severe morbidity and mortality worldwide (2). COVID-19 became the latest global pandemic as declared by the World Health Organisation (WHO) on the 19th of March 2020.
Methods encouraged to reduce transmission included social distancing, hand washing and the use of personal protective equipment. Furthermore, the United Kingdom (UK) government ordered a national lockdown as a response to the first peak of the pandemic on the 23rd of March 2020. Since then, further national and local lockdowns have been imposed in an effort to curb viral transmission particularly in response to challenges arising from new mutations of the virus, most recently the delta variant.

In order to fully re-open society safely, mass vaccination of the community is key. There has been a rapid development of a number of vaccines against SARS-CoV-2, some of which have relied on technology not previously used in human vaccines development such as the new mRNA vaccines. These vaccines have been proven to be generally safe with efficacy figures of up to 95% (3). It is hypothesised that to stop transmission effectively 70–85% of the population need to be vaccinated. Vaccine hesitancy, defined by the WHO as a delay in acceptance or refusal of safe vaccines despite availability (4), may hinder this effort and thus prove to be a major barrier in the re-opening of society.

As reported by Public Health England (PHE), ethnic minority populations have been disproportionately affected by the pandemic (5). The recent government white paper has also highlighted this added morbidity and mortality, as well as other key issues on social inequalities, underlying comorbidities, discrimination, racism and occupational risk (5). Despite the added burden of COVID-19 on ethnic minority populations, evidence is emerging that suggests a lower uptake of the vaccine in ethnic minority populations compared to other ethnic groups, being least in Black females of reproductive age (6). Similarly, vaccine hesitancy appears to be higher in ethnic minority individuals, possibly relating to misinformation surrounding COVID-19 (7). Furthermore, the UK household longitudinal study reported higher vaccine hesitancy in women being profoundly highest amongst individuals of Black ethnicity (8). There are many postulations as to why ethnic minorities may not be willing to take the vaccine, such as concerns regarding the long term effects of the vaccine and the speed in which it was developed (9). However, without fully understanding these concerns, mass voluntary vaccination is unlikely to be possible.

Individuals of ethnic minority are also more likely to work as front-line workers (10). Front-line workers are more exposed to the virus and more likely to transmit the disease to their cohabiting family members (11). Furthermore, pregnant women of ethnic minority background, who are being looked after by midwives through regular face to face encounters, are also more likely to be hospitalised and suffer adverse outcomes secondary to COVID-19 (12) and are the group of patients who are likely to benefit from the vaccine the greatest.

Given the racial disparities and differing attitudes towards the COVID-19 vaccine as well as local data from Barts Health which suggested midwives were the least likely amongst healthcare staff to accept COVID-19 vaccination a study was undertaken to explore vaccine uptake rates as well as the reasons for vaccine hesitancy amongst midwives in two ethnically diverse UK national health service (NHS) trusts. The aim was to explore the factors that drive decision making regarding COVID-19 vaccination uptake
among this workforce cohort and undertake a thematic analysis of midwifery views towards vaccine hesitancy.

Methods

A mixed methods qualitative and quantitative survey of midwives employed in two large teaching hospitals, situated in London (Barts Health NHS Trust) and Sussex (Brighton and Sussex University Hospitals NHS Trust - BSUH) was undertaken. A previously focus grouped questionnaire consisting of 45 questions was circulated electronically to all midwives working in the two NHS Trusts over a six-week period. Midwives were asked whether they had received their COVID-19 vaccination, followed by a series of questions exploring the factors that influenced their decision and concerns regarding the COVID-19 vaccine. The survey was advertised via email, local trust bulletins and social media. Informed consent was obtained on filling the questionnaire. The data was collected on Microsoft Excel and analysed on both Microsoft Excel and SPSS (version 27).

Demographics were compared. Categorical variables with no natural ordering to the categories were compared between groups using the Chi-square test, or Fisher’s exact test if the numbers in some categories were small. Categorical variables with a natural ordering to the categories were compared between Trusts and Black/White midwives using the Mann-Whitney test. The Kruskal-Wallis test was used to compare these factors between the three ethnic groups.

Subsequently the difference in outcomes between trusts and ethnic groups was examined. For each outcome analyses were performed with and without adjustment for variables. Analysis of COVID-19 vaccine acceptance and related outcomes and were all binary in nature (either yes or no). Therefore, logistic regression analysis and multiple logistic regression analysis was carried out.

Other outcomes related to concerns about the vaccine. Midwives were given three outcome options as to their level of concern: no, don’t know, yes. These were all assumed to be ordinal outcome, and thus the analyses were performed using ordinal logistic regression. The same approach to the analyses was made as to that described for the binary outcomes.

The next analyses considered the differences in outcome between trusts and between ethnic groups. In addition to these two key variables, variables showing some evidence of a difference between either trusts or ethnicities were also adjusted for. Therefore, the regression models contained the following predictor variables: trust, ethnicity, age, experience and midwifery grade (band).

Differences in outcome between trusts and between different ethnicities were adjusted for possible confounding variables. Due to the binary nature of the outcomes, these are expressed as odds ratios, and presented with corresponding confidence intervals, with and without an adjustment for potentially confounding variables.
Lastly, we performed a thematic analysis of the qualitative data relating to responses to two open questions regarding midwives’ personal views on the COVID-19 vaccine, and what they believe would increase vaccine uptake.

**Results**

A total of 378 midwives responded from both teaching hospitals: 228 out of 580 at Barts Health and 150 out 288 at BSUH, translating to a respondent rate of 39% and 52% respectively. Across both trusts 282 midwives had accepted the COVID-19 vaccine (75%).

Table 1 summarises the demographic characteristic of the midwives in the two trusts. The two trusts varied statistically in terms of ethnicity and age. Midwives from Barts Health were generally younger, with 50% aged under 40, compared to only 36% from BSUH. Almost all BSUH staff were of white ethnicity compared to under half of Barts Health staff (48%). Over a third of Barts staff were of black ethnicity, compared to no staff from BSUH. No differences were observed in gender, band, experience and general health level.
Table 1
Demographics by Trust

| Factor   | Category     | BSUH [N = 150]         | Barts [N = 228]        | P-value |
|----------|--------------|------------------------|------------------------|---------|
|          |              | n          | n (%)                  | n          | n (%)                  |         |
| Age      | < 25         | 150        | 4 (3%)                 | 228        | 20 (9%)                | 0.01    |
|          | 25–29        | 10         | 7%                     | 38         | 17%                    |         |
|          | 30–34        | 19         | 13%                    | 29         | 13%                    |         |
|          | 35–39        | 19         | 13%                    | 26         | 11%                    |         |
|          | 40–44        | 28         | 19%                    | 15         | 7%                     |         |
|          | 45–49        | 17         | 11%                    | 29         | 13%                    |         |
|          | 50–54        | 23         | 15%                    | 31         | 14%                    |         |
|          | 55–59        | 25         | 17%                    | 29         | 13%                    |         |
|          | ≥ 60         | 5          | 3%                     | 11         | 5%                     |         |
| Gender   | Female       | 149        | 148 (99%)              | 226        | 224 (99%)              | 1.00    |
|          | Male         | 1          | 1%                     | 2          | 1%                     |         |
| Ethnicity| White        | 150        | 145 (97%)              | 224        | 108 (48%)              | < 0.001 |
|          | Black        | 0          | 0%                     | 80         | 36%                    |         |
|          | Asian        | 1          | 1%                     | 12         | 5%                     |         |
|          | Mixed race   | 4          | 3%                     | 15         | 7%                     |         |
|          | Other        | 0          | 0%                     | 9          | 4%                     |         |
| Band     | Band 5       | 150        | 14 (9%)                | 223        | 27 (12%)               | 0.57    |
|          | Band 6       | 96         | 64%                    | 127        | 57%                    |         |
|          | Band 7       | 36         | 24%                    | 52         | 23%                    |         |
|          | Band 8       | 4          | 3%                     | 17         | 8%                     |         |
| Experience| 0–2 years   | 150        | 18 (12%)               | 227        | 46 (21%)               | 0.18    |
|          | 3–5 years    | 28         | 19%                    | 33         | 15%                    |         |
|          | 6–10 years   | 32         | 21%                    | 43         | 19%                    |         |
|          | 10–15 years  | 21         | 14%                    | 43         | 19%                    |         |
|          | > 15 years   | 51         | 34%                    | 62         | 27%                    |         |
| General  | Poor / fair  | 149        | 9 (6%)                 | 226        | 12 (5%)                | 0.54    |
Comparisons of the demographic characteristics of different ethnic groups were also made, with specific focus on the differences in staff of black and white ethnicity. A summary of the results is shown in Table 2. The results demonstrate a difference in the age of the three ethnicity groups, and also between black and white midwives, with white midwives being typically younger than black midwives. Almost half (46%) of white midwives were aged under 40, whilst the equivalent figure was only 24% for black midwives.

**Table 2**

*Demographics by Ethnicity*
| Factor       | Category | White [N=253] | Black [N=80] | Other [N=41] | P-value | Overall (*), B vs. W (**) |
|--------------|----------|---------------|--------------|--------------|---------|--------------------------|
|              |          | n          | n (%)        | n           | n (%)   |                         |                         |
| Age          | < 25     | 253        | 11 (4%)      | 80          | 3 (4%)  | 41                       | 9                       | <0.001, <0.001           |
|              | 25 – 29  | 36         | 14%          | 4           | 5%      | 8                        | 20%                     |
|              | 30 – 34  | 36         | 14%          | 4           | 5%      | 7                        | 17%                     |
|              | 35 – 39  | 35         | 14%          | 8           | 10%     | 2                        | 5%                      |
|              | 40 – 44  | 29         | 11%          | 12          | 15%     | 2                        | 5%                      |
|              | 45 – 49  | 30         | 12%          | 10          | 13%     | 5                        | 12%                     |
|              | 50 – 54  | 33         | 13%          | 19          | 24%     | 2                        | 5%                      |
|              | 55 – 59  | 33         | 13%          | 17          | 21%     | 4                        | 10%                     |
|              | ≥ 60     | 10         | 4%           | 3           | 4%      | 2                        | 5%                      |
| Gender       | Female   | 251        | 249 (99%)    | 80          | 79 (99%)| 41                       | 41 (100%)               | 0.69, 0.57              |
|              | Male / Non-Binary | 2 (1%) | 1 (1%) | 0 (0%) |
| Band         | Band 5   | 251        | 27 (11%)     | 79          | 7 (9%) | 40                       | 7 (18%)                 | 0.08, 0.08              |
|              | Band 6   | 154        | 61%          | 43          | 54%     | 24                       | 60%                     |
|              | Band 7   | 60         | 24%          | 19          | 24%     | 8                        | 20%                     |
|              | Band 8   | 10         | 4%           | 10          | 13%     | 1                        | 3%                      |
| Experience   | 0 – 2 years | 253    | 40 (16%)     | 80          | 9 (11%)| 40                       | 14 (35%)                | <0.001, 0.008           |
|              | 3 – 5 years | 47       | 19%          | 8           | 10%    | 5                        | 13%                     |
|              | 6 – 10 years | 56      | 22%          | 9           | 11%    | 10                       | 25%                     |
| Experience    | Black Midwives | White Midwives | Other Midwives | Total  |
|---------------|----------------|----------------|---------------|--------|
| 10 – 15 years | 36 (14%)       | 24 (30%)       | 3 (8%)        | 63     |
| >15 years     | 74 (29%)       | 30 (38%)       | 8 (20%)       | 112    |
| General       | 252            | 79             | 41            | 372    |

| Health        | Black Midwives | White Midwives | Other Midwives | Total  |
|---------------|----------------|----------------|---------------|--------|
| Poor / fair   | 15 (6%)        | 79             | 5 (6%)        | 139    |
| Good          | 61 (24%)       | 19 (24%)       | 15 (37%)      | 95     |
| Very good     | 110 (44%)      | 29 (37%)       | 14 (34%)      | 153    |
| Excellent     | 66 (26%)       | 26 (33%)       | 11 (27%)      | 103    |

(*) P-values indicating the significance of the overall difference between the three ethnic groups
(**) P-values indicating the significance of the difference between Black and White midwives

There was also a difference in midwifery experience between ethnic groups. Black midwives were typically the most experienced, with over two-thirds (68%) having at least 10 years of experience, compared to only 43% of white midwives.

Table 3 summarises the results on previous COVID-19 infection and vaccination uptake rates between midwives from the two trusts. The unadjusted results suggest that Barts Health midwives were more likely to test positive for COVID-19 (OR = 2.60, p = 0.001) and less likely to have received the COVID-19 vaccine (OR = 0.30, p < 0.001). Barts Health midwives were also more likely to have a family member affected by COVID-19 (33% vs 19.5%, p = 0.04). No significant difference was noted when asked if midwives were able to self-isolate on testing positive (53% vs 53%, OR = 0.98, p = 0.984).

After adjusting for potential confounding variables, including ethnicity, there was no significant differences between trusts in receipt of the COVID-19 vaccine (OR = 0.57, p = 0.13). Midwives at Barts Health were significantly more likely to have tested positive for COVID-19 compared to midwives at BSUH (adjusted OR = 2.47, p = 0.01)

The same outcomes were compared between ethnicities as shown on Table 4. Whilst data from all ethnicities was included in the analysis, we focused on the difference between black and white staff, because of the small numbers of the other ethnicities and only results for these two groups are presented. Although there was no statistical difference between ethnicities in testing positive for COVID-19 (adjusted OR = 1.07, P = 0.86), midwives of black ethnicity were over 4 times less likely to have received a COVID-19 vaccine compared to white ethnicity midwives, both before and after adjusting for potentially confounding variables (52% vs 85%, adjusted OR = 0.22, p,0.001). The two ethnic groups did not significantly vary in terms of their ability to self-isolate (adjusted OR = 0.61, p = 0.16). Midwives of black ethnicity were more likely to have a family member affected by COVID-19 (35% vs 24%, p = 0.049).
### Table 3

**COVID-19 and vaccination outcomes by Trust**

| Factor                   | Category | BSUH [N=150] | Barts [N=228] | Unadjusted | Adjusted (+) |
|--------------------------|----------|--------------|---------------|------------|--------------|
|                          | n        | n (%)        | n             | n (%)      | OR (95% CI)  | P-value | OR (95% CI) | P-value |
| Opposition to flu        | No       | 148          | 226           | 121 (82%)  | 166 (73%)   | 1.61 (0.97, 2.70) | 0.06 | 1.12 (0.57,2.26) | 0.73 |
|                          | Yes      | 27 (18%)     | 60 (27%)      | 19 (13%)   | 74 (33%)    | 0.30 (0.17, 0.52) | **<0.001** | 0.57 (0.28, 1.18) | 0.13 |
| Received COVID           | No       | 149          | 226           | 19 (13%)   | 74 (33%)    | 0.30 (0.17, 0.52) | **<0.001** | 0.57 (0.28, 1.18) | 0.13 |
|                          | Yes      | 130 (87%)    | 152 (67%)     | 70 (47%)   | 105 (47%)   | 1.00 (0.66, 1.52) | 0.98 | 1.29 (0.74, 2.27) | 0.37 |
| Able to self-isolate     | No       | 149          | 224           | 70 (47%)   | 105 (47%)   | 1.00 (0.66, 1.52) | 0.98 | 1.29 (0.74, 2.27) | 0.37 |
|                          | Yes      | 79 (53%)     | 119 (53%)     |           |            |               |     |               |     |
| Tested COVID             | No       | 149          | 226           | 129 (87%)  | 161 (71%)   | 2.60 (1.50, 4.52) | **0.001** | 2.47 (1.24, 4.88) | **0.01** |
| positive in past         | Yes      | 20 (13%)     | 65 (29%)      |           |            |               |     |               |     |

(* Odds ratios expressed as odds of a yes outcome for Barts staff relative to odds for BSUH staff

(+) Trust differences adjusted for: age, band, experience and ethnicity

### Table 4

**COVID-19 and Vaccination outcomes by Ethnicity (White and Black ethnicities only)**
In the trust comparison, the result for flu vaccine opposition was only of borderline statistical significance. After adjusting for potential confounding variables, including ethnicity, there was no significant differences between trusts for opposition to the flu vaccine (OR = 1.12, P = 0.73). When comparing ethnicities, opposition to the flu vaccine was highest in black midwives (adjusted OR = 2.87, p = 0.005).

Tables 5 and 6 present a comparison of concerns relating to the COVID-19 vaccine hesitancy between the two trusts. Differences between trusts, both unadjusted and adjusted for possible confounding variables, are expressed as odds ratios. The unadjusted analyses suggested that all concerns varied significantly between the two trusts, with midwives from Barts Health having a significantly higher prevalence of concerns than BSUH midwives. After adjusting for ethnicity and other factors included in the regression models, differences in concerns relating to long term effects of the vaccine, interference with genetic
code, as well as concerns that the vaccine contains meat products or fetal tissue, or that it would have adverse effects specifically on ethnic minorities, were no longer statistically significant. However, some of the trust differences were still prevalent even after adjustments namely concerns relating to the vaccine being developed too fast (adjusted OR = 2.06, p = 0.01), allowing the government to track individuals (adjusted OR = 9.13, p = 0.001), interfering with fertility (adjusted OR = 2.02, p = 0.03), or catching COVID-19 from the vaccine (adjusted OR = 7.22, p = 0.006) were significantly higher amongst Barts Health midwives compared to BSUH midwives. Concerns relating to an allergic reaction was of borderline statistical significance (adjusted OR = 2.01, p = 0.05).

More midwives at Barts Health were aware of the Tuskegee Syphilis Trial compared to BSUH (p = 0.004). When asked if they would prefer a choice in the type of vaccine received similar numbers at both sites answered in the positive, 70% and 67% at Barts Health and BSUH respectively (p = 0.572).

Tables 7 and 8 present a comparison of concerns relating to the COVID-19 vaccine hesitancy between midwives of black and white ethnicity. All concerns examined varied significantly between black and white midwives in the unadjusted analyses. These differences persisted for all outcomes even after adjusting for potentially confounding factors for the majority of concerns examined, with the exception of catching COVID-19 from the vaccine which did not quite reach statistical significance after adjusting for confounding factors. For all concerns, black ethnicity midwives had a higher occurrence of concerns than white midwives. The most pronounced difference was that of concerns relating to the long-term effects of the vaccine (adjusted OR = 4.97, p < 0.001), concerns relating to the speed in which the vaccine was developed (adjusted OR = 5.59, p < 0.001) and concerns regarding the vaccine containing meat products (adjusted OR = 6.31, p < 0.001).

More black midwives were aware of the Tuskegee Syphilis Trial compared to white midwives (p < 0.001). When asked if they would prefer a choice in the type of vaccine, there was no significant difference between the two ethnicities with both groups answering in the positive, 72% and 65% amongst black and white midwives respectively (p = 0.572).

Table 5

Vaccine concerns by Trust (part 1)
| Concern                      | Category     | BSUH [N=150] | Barts [N=228] | Unadjusted | Adjusted (*) |
|------------------------------|--------------|--------------|---------------|------------|--------------|
|                              | n            | n (%)        | n             | n (%)      | OR (95% CI) (*) | P-value | OR (95% CI) (*) | P-value |
| Long term effects            | No           | 145          | 95 (66%)      | 201        | 77 (38%)     | 2.72 (1.77, 4.19) | <0.001 | 1.39 (0.80, 2.40) | 0.24 |
|                              | Don't know   | 10           | 7 (5%)        | 31         | 15 (7%)      | 2.06 (0.99, 4.07) | 0.05  |
|                              | Yes          | 40           | 28 (14%)      | 93         | 46 (21%)     | 2.01 (0.99, 4.07) | 0.24  |
| Allergic reaction            | No           | 145          | 123 (85%)     | 201        | 124 (62%)    | 3.32 (1.95, 5.65) | <0.001 | 2.01 (0.99, 4.07) | 0.05 |
|                              | Don't know   | 1            | 1 (1%)        | 13         | 6 (3%)       | 1.63 (0.72, 3.67) | 0.05  |
|                              | Yes          | 21           | 14 (6%)       | 64         | 32 (14%)     | 1.63 (0.72, 3.67) | 0.05  |
| Interfere with               | No           | 144          | 127 (88%)     | 201        | 151 (75%)    | 2.44 (1.34, 4.44) | 0.003 | 1.63 (0.72, 3.67) | 0.24 |
|                              | Don't know   | 11           | 8 (6%)        | 34         | 17 (7%)      | 1.63 (0.72, 3.67) | 0.05  |
|                              | Yes          | 6            | 4 (2%)        | 16         | 8 (4%)       | 1.63 (0.72, 3.67) | 0.05  |
| Developed too fast           | No           | 145          | 103 (71%)     | 201        | 87 (43%)     | 3.57 (2.30, 5.56) | <0.001 | 2.06 (1.17, 3.62) | 0.01 |
|                              | Don't know   | 26           | 18 (12%)      | 37         | 18 (12%)     | 2.06 (1.17, 3.62) | 0.01  |
|                              | Yes          | 16           | 11 (7%)       | 77         | 39 (17%)     | 2.06 (1.17, 3.62) | 0.01  |
| Government able              | No           | 144          | 140 (97%)     | 200        | 154 (77%)    | 10.6 (3.71, 30.1) | <0.001 | 9.13 (2.61, 32.0) | 0.001 |
|                              | Don't know   | 4            | 3 (2%)        | 33         | 17 (7%)      | 2.06 (1.17, 3.62) | 0.01  |
|                              | Yes          | 0            | 0 (0%)        | 13         | 7 (3%)       | 2.06 (1.17, 3.62) | 0.01  |
| Interfere                    | No           | 145          | 118 (78%)     | 200        | 106 (53%)    | 3.68 (1.82, 7.43) | <0.001 | 2.02 (1.01, 4.05) | 0.03 |
| fertility | Don’t know | 13 (9%) | 49 (25%) |
|-----------|------------|---------|----------|
|           | Yes        | 14 (10%) | 45 (23%) |

(*) Odds ratios expressed as odds of next highest outcome category for Barts staff relative to odds for BSUH staff

(+) Trust differences adjusted for: age, band, experience and ethnicity

Table 6

Vaccine concerns by Trust (part 2)
| Concern                  | Category       | BSUH    | Barts   | Unadjusted | Adjusted (+) |
|-------------------------|----------------|---------|---------|------------|--------------|
|                         | N=150          | N=228   |         |            |              |
|                         | n   | n (%) | n   | n (%) | OR (95% CI) (*) | P-value | OR (95% CI) (*) | P-value |
| Made of porcine / meat products | No  | 145   | 134 (92%) | 201 | 163 (81%) | 2.83 (1.40, 5.76) | 0.004 | 1.19 (0.46, 3.08) | 0.72 |
|                         | Don't know     | 9      | 6 (6%)  | 31 | (15%) | 1.19 (0.46, 3.08) | 0.72 |
|                         | Yes            | 2      | 1 (1%)  | 7  | (3%) | 1.19 (0.46, 3.08) | 0.72 |
| Contains fetal tissue   | No  | 145   | 126 (87%) | 201 | 148 (74%) | 2.38 (1.34, 4.22) | 0.003 | 1.66 (0.77, 3.56) | 0.20 |
|                         | Don't know     | 13     | (9%)    | 34  | (17%) | 1.66 (0.77, 3.56) | 0.20 |
|                         | Yes            | 6      | 4 (4%)  | 19  | (9%) | 1.66 (0.77, 3.56) | 0.20 |
| Adverse effect on ethnic minorities | No  | 145   | 100 (69%) | 201 | 115 (75%) | 1.84 (1.18, 2.86) | 0.007 | 1.17 (0.65, 2.10) | 0.60 |
|                         | Don't know     | 42     | 29 (29%) | 61  | (31%) | 1.17 (0.65, 2.10) | 0.60 |
|                         | Yes            | 3      | 2 (2%)  | 25  | (12%) | 1.17 (0.65, 2.10) | 0.60 |
| Get coronavirus from vaccine | No  | 145   | 142 (98%) | 201 | 169 (43%) | 8.78 (2.63, 29.3) | <0.001 | 7.22 (1.78, 29.3) | 0.006 |
|                         | Don't know     | 0      | 0 (0%)  | 17  | (8%) | 7.22 (1.78, 29.3) | 0.006 |
|                         | Yes            | 3      | 2 (2%)  | 15  | (7%) | 7.22 (1.78, 29.3) | 0.006 |

(*) Odds ratios expressed as odds of next highest outcome category for Barts staff relative to odds for BSUH staff

(+) Trust differences adjusted for: age, band, experience and ethnicity

Table 7
Vaccine concerns by Ethnicity (White and Black ethnicities only) (part 1)
| Concern                                             | Category       | White [N=253] | Black [N=80] | Unadjusted | Adjusted (+) |
|-----------------------------------------------------|----------------|---------------|--------------|------------|--------------|
|                                                     |                | n | n (%) | n | n (%) | OR (95% CI) (†) | P-value | OR (95% CI) (†) | P-value |
| Long term effects                                   | No             | 242 | 146 (60%) | 69 | 12 (17%) | 5.26 (3.05, 9.98) | <0.001 | 4.97 (2.55, 9.70) | <0.001 |
|                                                     | Don't know     | 26 | 12 (17%)  | 12 | 12 (17%) |
|                                                     | Yes            | 70 | 45 (65%)  | 45 | 45 (65%) |
| Allergic reaction                                   | No             | 242 | 198 (82%) | 69 | 30 (43%) | 5.25 (3.01, 9.18) | <0.001 | 4.20 (2.02, 8.70) | <0.001 |
|                                                     | Don't know     | 4  | 2 (2%)    | 7  | 7 (10%)  |
|                                                     | Yes            | 40 | 32 (46%)  | 32 | 32 (46%) |
| Interfere with                                      | No             | 241 | 211 (88%) | 69 | 42 (61%) | 3.97 (2.17, 7.26) | <0.001 | 3.23 (1.45, 7.18) | 0.004 |
|                                                     | Don't know     | 16 | 16 (7%)   | 22 | 22 (32%) |
|                                                     | Yes            | 14 | 5 (7%)    | 5  | 5 (7%)   |
| Developed too fast                                  | No             | 242 | 160 (66%) | 69 | 15 (22%) | 7.64 (4.40, 13.3) | <0.001 | 5.59 (2.87, 10.9) | <0.001 |
|                                                     | Don't know     | 42 | 42 (17%)  | 12 | 12 (17%) |
|                                                     | Yes            | 40 | 40 (17%)  | 42 | 42 (61%) |
| Government able                                     | No             | 240 | 225 (94%) | 69 | 41 (59%) | 10.3 (5.06, 20.8) | <0.001 | 3.38 (1.42, 8.05) | 0.006 |
|                                                     | Don't know     | 11 | 11 (5%)   | 20 | 20 (29%) |
|                                                     | Yes            | 4  | 4 (2%)    | 8  | 8 (12%)  |
| Interfere with                                      | No             | 242 | 177 68 | 29 | 3.22 | <0.001 | 3.56 | <0.001 |
| Fertility | Don't know | 34 (14%) | 21 (31%) |
|-----------|------------|----------|----------|
| Yes       | 31 (13%)   | 18 (26%) |

(*) Odds ratios expressed as odds of next highest outcome category for Black midwives relative to odds for White midwives

(+) Ethnic differences adjusted for: age, band, experience and Trust

Table 8

Vaccine concerns by Ethnicity (White and Black ethnicities only) (part 2)
| Concern                                | Category          | White  | Black  | Unadjusted | Adjusted (+) |
|----------------------------------------|-------------------|--------|--------|------------|--------------|
|                                        |                   | [N=253]| [N=80] |            |              |
|                                        |                   | n   | n (%)  | n   | n (%)     | OR (95% CI) (*) | P-value | OR (95% CI) (*) | P-value |
| Made of porcine / meat products        | No                | 242 | 224 (93%) | 69 | 47 (68%) | 5.65 (2.82, 11.3) | <0.001 | 6.31 (2.46, 16.2) | <0.001 |
|                                        | Don’t know        | 14  | 6 (6%)   | 19 | 28 (28%) | 5.02 (1.25, 20.2) | 0.01     | 3.54 (1.63, 7.68) | 0.001 |
|                                        | Yes               | 4   | 2 (2%)   | 3  | 4 (4%)    | 2.07 (0.62, 6.84) | 0.04     | 2.42 (0.90, 6.50) | 0.08   |
| Contains fetal tissue                  | No                | 242 | 207 (86%) | 69 | 40 (58%) | 4.20 (2.34, 7.54) | <0.001 | 3.54 (1.63, 7.68) | 0.001 |
|                                        | Don’t know        | 22  | 9 (9%)   | 18 | 26 (26%) | 1.10 (0.43, 2.95) | 0.84     | 1.46 (0.41, 5.47) | 0.56   |
|                                        | Yes               | 13  | 5 (5%)   | 11 | 16 (16%) | 1.60 (0.72, 3.52) | 0.27     | 1.46 (0.41, 5.47) | 0.56   |
| Adverse effect on ethnic minorities    | No                | 242 | 168 (69%) | 69 | 29 (42%) | 3.47 (2.04, 5.92) | <0.001 | 3.85 (1.96, 7.52) | <0.001 |
|                                        | Don’t know        | 65  | 27 (27%) | 27 | 39 (39%) | 1.15 (0.66, 2.00) | 0.65     | 1.46 (0.41, 5.47) | 0.56   |
|                                        | Yes               | 9   | 4 (4%)   | 13 | 19 (19%) | 1.60 (0.72, 3.52) | 0.27     | 1.46 (0.41, 5.47) | 0.56   |
| Get coronavirus from vaccine           | No                | 242 | 230 (95%) | 69 | 52 (75%) | 5.96 (2.69, 13.2) | <0.001 | 2.42 (0.90, 6.50) | 0.08   |
|                                        | Don’t know        | 3   | 1 (1%)   | 10 | 14 (14%) | 5.02 (1.25, 20.2) | 0.01     | 3.54 (1.63, 7.68) | 0.001 |
|                                        | Yes               | 9   | 4 (4%)   | 7  | 10 (10%) | 5.02 (1.25, 20.2) | 0.01     | 3.54 (1.63, 7.68) | 0.001 |

(*) Odds ratios expressed as odds of next highest outcome category for Black midwives relative to odds for White midwives

(+) Ethic differences adjusted for: age, band, experience and Trust

Thematic analysis of the qualitative data collected was undertaken and is summarised in Figs. 2 and 3.
With regards to respondents' personal views on the COVID-19, midwives were predominantly positive across both sites, expressing happiness that the vaccine had been introduced and hope that it would be the solution to easing of restrictions and provide protection for vulnerable groups and their families. Respondents from both BSUH and Barts Health conveyed that they felt everyone ought to have the vaccine, and several responses from Barts Health suggested that the vaccine ought to be mandatory for healthcare workers. Concerns around the delayed second dose were prominent at both sites, as were anxieties around the long-term effects of the vaccine, and whether the vaccine affects fertility.

Several responses regarding how to improve vaccine uptake focused on the need for reliable and clear information which included summaries of the research trials and evidence on adverse effects. Across both sites, midwives suggested an approach similar to the influenza vaccine whereby vaccinators are present in clinical areas and if the vaccine is refused, the reason documented. Several people raised that staff who have concerns about the vaccine need an opportunity for individualised conversations to explore their concerns, and support from management teams may help. A further prominent theme was simply the need for more time, providing reassurance of the long-term safety and efficacy of the vaccine, and individuals should not be pressured into making a decision.

**Discussion**

To our knowledge, this study is the first qualitative and quantitative study to explore and report on COVID-19 vaccine uptake rates and reasons for vaccine hesitancy within midwives in the UK. Barts Health NHS Trust has three maternity units in London and is an ethnically diverse area that has been worse affected by COVID-19; BSUH is located in the South East of England, has been less affected by COVID-19 and has a less ethnically diverse population (5). This is consistent with our results, which demonstrate a higher infection rate with Barts health midwives being 2.5 times more likely to have tested positive for coronavirus and have a higher likelihood of having a family member affected by COVID-19 than their counterparts at BSUH. Despite these findings, vaccine uptake was significantly lower in Barts Health compared to BSUH midwives.

The only difference in demographic characteristics between Barts Health and BSUH were age and ethnicity, with the vast majority of BSUH midwives being of white ethnicity and no midwives of black ethnicity compared to Barts Health midwives where 47% were of white and 35% of Black ethnicity. It is therefore possible that differences between Barts Health and BSUH midwives are related to differences in ethnicity. This was evident in our results; more black midwives had a previous COVID-19 infection and significantly more had a family member affected. More importantly, ethnic minority black midwives were 4 times less likely to have accepted the COVID-19 vaccine compared to their white ethnicity counterparts.

There is no statistically significant difference in vaccine uptake between age, midwifery grade, healthcare setting, length in the profession or previous COVID-19 infection. The only demographic factor in our survey that determined the likelihood of a midwife to accept vaccination appears to be ethnicity, with black midwives being 4 times less likely to have received the COVID-19 vaccine than their white midwifery
colleagues. This suggests that the health disparately adverse outcomes of COVID-19 within ethnic minority populations may become more pronounced with higher rates of hospital admission and morbidity amongst people who have not been vaccinated.

Our study demonstrated no difference in the general health of our study group between ethnicities, with both white and black midwives being of equally good health. Our black ethnicity group of midwives were also generally older, had greater work experience and were of relatively higher band. This suggests that the differences in COVID-19 infections and vaccine uptake are unlikely to be solely related to social deprivation in ethnic minorities, as recently suggested by the relevant UK government report (13). Instead, our results suggest that factors beyond socioeconomic characteristics exist that contribute to health inequality between different ethnic groups.

Furthermore our study adds to existing evidence which suggests that this demographic has been disproportionately affected by the pandemic (14)(15)(16). A lower intention to be vaccinated in female individuals and those of black ethnicity became evident from earlier studies that explored and reported on intention to be vaccinated prior to the roll-out of the vaccine (6)(17)(18)(19)(20). A Cohort study in the United States (US) and UK demonstrated that individuals of black ethnicity have the highest rate of vaccine hesitancy amongst all ethnicities and a lower vaccine uptake rate in the black US population (16). Despite finding no disparities in vaccine receipt between white and black ethnicity in the UK population, they also reported higher vaccine hesitancy and lower uptake in healthcare workers and in females compared to males (16). Similarly, the UK household longitudinal study demonstrated higher vaccine hesitancy in women compared to men and even higher hesitancy in those of black ethnicity with an odds ratio for vaccine hesitancy of 13.42 (8). Furthermore, a cross-sectional surveillance in Leicester, reported significantly lower vaccination rates in females and black healthcare workers (21).

Our results demonstrate that black ethnicity midwives were more likely to be opposed to the influenza vaccine compared to white midwives, a vaccine with more evidence on safety that has been available for a longer period of time. This trend is similar to the one we have observed for the COVID-19 vaccine, therefore it is possible that further factors exist that drive the overall beliefs, perceptions and hesitancy of this population towards all types of vaccines, beyond any concerns that relate to the novelty of the COVID-19 vaccine. One such factor may be the deep-rooted mistrust of medicine and science amongst individuals of black ethnicity, highlighted by ethically unjustifiable historical work such as The Tuskegee Syphilis Study. The Tuskegee Study of Untreated Syphilis (22) was an ethically unjustified study performed on African American males between 1932 and 1972, the purpose of which was to observe the natural history of untreated syphilis. The study led to the unnecessary death of 128 of its participants, thus constituting a major violation of ethical standards. Our results demonstrate that the midwives of black ethnicity are more aware of this study both when comparing black to white ethnicity, but also when comparing midwives from Barts Health to those from BSUH. It is possible that the deep lingering mistrust into public health officials caused by such historical events is reflected several decades later and translates into health behaviours and attitudes consistent with vaccination hesitancy. Such historical
events may have traumatized generations for decades to come, to the point that certain ethnic groups may not access lifesaving public health interventions such as vaccination and screening programmes.

Regaining some of the lost trust requires an effort to promote evidence-based facts and reinforcement of positive examples. One of our aims was to establish the specific type and degree of concerns that hesitant groups have, in order to tailor education and improve knowledge amongst hesitant individuals. Our study noted that compared to BSUH, Barts Health midwives were twice as likely to have concerns relating to the vaccine being developed too fast, causing allergic reactions or interfering with fertility, 7 times more likely to worry that they would catch COVID-19 from the vaccine and 9 times more likely to believe that the vaccine would allow the government to track individuals. Similarly, all concerns examined were significantly more apparent in black compared to white ethnicity midwives, with the exception of catching COVID-19 from the vaccine. The most profound discrepancies were in concerns relating to the long-term effects of the vaccine (5x), possible allergic reactions (4x), the speed in which the vaccine was developed (over 5x) and concerns that the vaccine may contain meat products (6x). It is clear that these concerns need to be addressed with a targeted educational programme at local and national levels to drive up vaccine uptake in these populations groups. Although resources are being published by the NHS, namely targeted at the lay population, a strong theme in the analysis of the qualitative responses to this survey highlighted the need for information breakdowns with clear statistics, as opposed to general information, in order to provide transparency. Information included must address the most common concerns raised in those who have not yet been vaccinated more specifically, the safety profile of the vaccine including its rapid development. In addition, such programs should emphasize that the vaccine does not contain meat products, or a live virus that would allow infection and most importantly that there is complete lack of evidence for any effect on fertility, or any feasible mechanism via which the latter could occur. Lastly, we must reassure individuals that although the long-term effects of the vaccine are unknown, it is unlikely that these will arise. On the contrary, evidence currently exists that the possible long-term effects of COVID-19 infection in the form of ‘long COVID’ are likely to be worse than any potential rare complications (23).

One recent topical vaccine concern was the rare incidence of venous thromboembolism after administration of the Astrazeneca COVID-19 vaccine (24). Admittedly, our study did not explore vaccine hesitancy for each of the different vaccine types, however, when midwives were questioned if they would have a preference or choice in the type of vaccine, there was no significant difference between the two ethnicities with both groups answering in the positive. Therefore, any hesitation relating to the type of vaccine is unlikely to constitute the cause of vaccine uptake disparity between the two ethnic groups.

A limitation of our study is that of selection and representation bias, as it presents the views of those that are more likely to engage into the survey taking process. Despite a total survey uptake of over 70% of those polled, it is possible that only individuals with a particular interest or strong opinion in COVID responded to the survey, thus introducing reporting bias. Although a large enough number of midwives responded to our survey to allow comparison between white and black ethnicity midwives, the number was not large enough to allow the comparison and presentation of data for other ethnic groups that were
less well represented in our population sample. Our study presents a valuable snapshot of midwives’ views on COVID-19 vaccination at this given time. However, it does not allow assessment of possible changes and shifts in opinion that may arise over time, for example due to new information presented to the respondents. Nevertheless, repeating the survey will allow us to observe any changes in opinion following interventions such as targeted education programs as outlined above.

Recent reports have highlighted concerns regarding unequal access to the vaccine, the electronic booking system, as well as to reliable resources that aid decision making in individuals of black ethnicity (9)(25). Our study established that information resources were similar between the two ethnic groups, with the most frequently occurring information resources originating from the government, the television and work newsletters. Therefore, these mediums constitute the most effective means in which we can maximise the delivery of reliable information in order to tackle disparities in vaccine uptake. A randomized controlled trial performed in the UK and the US (26) showed that relative to factual information, recent misinformation induced a decline in intent to be vaccinated in individuals who stated that they would definitely accept a vaccine. This demonstrates that individuals’ opinion is amenable and easily influenced by real-time changes to available information and emphasizes the need to deliver valid facts in an equitable manner.

It has been demonstrated that a significant proportion of COVID-19 inpatients acquire infection in hospital, through healthcare worker to patient transmission (27). Improving vaccine uptake amongst midwives is expected to have a protective effect in preventing nosocomial infection of COVID-19 in pregnant women and their partners. Healthcare workers are also often deemed as trusted messengers that influence their wider ethnic communities. Midwives can be particularly influential when counselling pregnant women (28). The latest advice from the Joint Committee on vaccination and immunization (JCVI) is that COVID-19 vaccines should be offered to pregnant women at the same time as the rest of the population based on their age and clinical risk group. The Royal College of Obstetrician and Gynaecologists (RCOG) states that women are expected to discuss the benefits and risks of having the vaccine with their healthcare professional, which in the majority of cases is the woman’s midwife, and reach a joint decision based on individual circumstances. Pregnant women are worse affected by COVID-19, with those of black and other ethnic minorities being disproportionately affected (12). Unless we urgently tackle misinformation and appropriately train and educate our midwives, it is likely that the vaccine hesitancy highlighted in our study population may have an indirect effect on the pregnant women’s views and potentially exacerbate any effect of ethnicity on vaccine uptake rates in the pregnant population. Similarly, improving vaccine uptake in this group is likely to have a secondary positive effect in their corresponding communities. This highlights the importance of keeping midwives engaged into vaccination efforts even after they have themselves been vaccinated, so that they can be trained to become true health ambassadors that assist their families, communities and patients in the decision-making process.

Conclusions
Midwives in London have been worse affected by the COVID-19 pandemic than their midwifery counterparts in the South East of England, yet they were less likely to have accepted a COVID-19 vaccine. The only demographic factor in our survey that determined the likelihood of a midwife accepting vaccination is ethnicity, with ethnic minority black midwives being 4 times less likely to have received the COVID-19 vaccine than their white counterparts. Our survey constitutes yet another example of how the COVID-19 pandemic has highlighted racial healthcare disparities, as those most affected by the disease appear to be the ones that are least likely to accept vaccination. Our evidence supports that factors beyond socioeconomic deprivation exist that contribute to health inequality between different ethnic groups. Efforts should therefore focus on tackling any discrepancy in vaccine uptake between white and black ethnicity midwives. Our study presents current insights into midwives’ views and concerns relating to the COVID-19 vaccine and highlights issues that necessitate targeted action as part of the wider public health response. It is imperative that there are clear educational strategies developed at a local and national level to improve knowledge and engage vaccine hesitant groups, in order to increase vaccine uptake. The introduction of such interventions requires constant effort and reassessment in order to establish any changes in opinion or new concerns that may arise. Midwives play a vital role in building and sustaining vaccine confidence and trust in the pregnant population, thus appropriate education and training of this group is likely to have a positive effect in pregnant women at a population level.

**Abbreviations**

BSUH: Brighton and Sussex University Hospitals NHS Trust

COVID-19: Coronavirus disease 2019

SARS-CoV-2: Severe acute respiratory syndrome coronavirus-2

WHO: World Health Organisation

PHE: Public Health England

US: United States

UK: United Kingdom

NHS: National Health Service

JCVI: Joint Committee on vaccination and immunization

RCOG: Royal College of Obstetrician and Gynaecologists (RCOG)

**Declarations**
Ethics approval and consent

The Research and Development departments at Barts Health and Brighton and Sussex University Hospitals were consulted before starting data collection and it was deemed that ethical approval was not required.

Informed consent was obtained from all participants when filling the questionnaire.

All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication

Informed consent was obtained from all participants when filling the questionnaire.

All methods were performed in accordance with the relevant guidelines and regulations.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare they have no competing interests.

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Author contributions

FO conceptualised the project and designed the questionnaire. RA, KM, DO and MO further developed the questionnaire and assisted in the electronic circulation to participants. KM and DO conducted the initial focus group. ND, MH, CS, RM, CN, RO, MO and KT contributed to data collection. RM, MH and CS performed the data analysis. FO and CN performed the literature review. FO, CN, RM and CS are the primary authors of the manuscript. All authors approved the final manuscript.

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**Figures**

Figure 1

Bar Chart showing where midwives across Barts Health and BSUH accessed information regarding the COVID-19 vaccine
Figure 2

Word Cloud showing responses to 'What are your personal views on the COVID-19 Vaccine? Separated by site

delayed 2nd dose
care of safety
essential, exciting
more information
safe
protect others
happy
trust
too early
important
impressed speed
reduces risk
selfish
longterm effects
solution pandemic
everyone should

Barts Health

Figure 3

Word Cloud showing responses to 'What do you think would be useful to increase the uptake of COVID-19 vaccinations?' Separated by site

longterm effects
protects people
compulsory in healthcare workers
unsure effectiveness
necessary
import safe
fake news
trust science
new strains
being pushed
reduced illness
pregnancy control

Barts Health