

1 Women's Experience of Pregnancy and Birth during the Covid-19 pandemic: a qualitative
2 study

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26 **Abstract**

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28 **BACKGROUND:** The COVID-19 pandemic has changed how maternity care services are
29 provided worldwide. In an effort to contain the virus many providers have reduced the
30 number of face-to-face visits for women. In addition, partner attendance is now prohibited in
31 many circumstances in order to protect staff, and other service users, from potential
32 infection.

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34 **METHODS:** A qualitative study with 14 women was conducted using a grounded
35 theory approach. Data were collected between April to June 2020 and in-depth interviews
36 were conducted either in pregnancy or in the first 12 weeks after the birth.

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38 **RESULTS:**

39 Six categories emerged: loss of normality, navigating “new” maternity care systems, partners
40 as bystanders, balancing information, uncertainty, and unexpected benefits of pregnancy
41 during the pandemic. Women described the challenges they faced with accessing information
42 on the risk of COVID-19 in pregnancy specifically and how to navigate the new hospital and
43 community restrictions. For the most part women accepted many of the restrictions as they
44 understood as being in place to keep them safe. They perceived themselves as a vulnerable
45 group despite apparent available evidence to the contrary. The loss of the partner as an
46 advocate, particularly at the anomaly scan and in the neonatal intensive care, was a source
47 of anxiety. Social media was the main source of information for many in place of traditional
48 sources such as healthcare providers. Some unexpected benefits of restrictions included

49 working from home which allowed women to manage normal pregnancy symptoms such as
50 fatigue at home.

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52 **CONCLUSION:** The pandemic caused anxiety for pregnant women. This is exacerbated by
53 uncertainty about the effects of COVID-19 on pregnancy and unclear messaging about
54 restrictions. Pregnancy has a significant temporal component and so maternity services need
55 to respond to women's needs for information and support rapidly
56 and effectively, with more interactive and personalised communication to support them to
57 cope with uncertainty. The birth partner is an important role as an advocate for women.
58 Containment strategies for the pandemic should be developed with this in mind and attempt
59 to view the family as a unit rather than the woman in isolation.

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62 Words: 347 of 350 permitted

63 Keywords: women, pregnancy, experience, COVID

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73 **Background**

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75 With the declaration of COVID-19 as a Public Health Emergency in January 2020(1), maternity
76 services had to adapt quickly and change how care was provided. The time sensitive nature
77 of provision of maternity care meant that the cancellation of services was not an option.
78 Changes made included reduced face to face hospital visits, partners and visitors were asked
79 not to attend routine appointments and ultrasounds, strict visiting restrictions were placed in
80 the Neonatal Intensive Care Unit (NICU), allowing only the mother to visit infants for a limited
81 time per day. In addition, the postnatal wards were closed to visitors including partners.

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83 Early data on the COVID-19 infection in pregnancy was reassuring(2); however, initial studies
84 were based on small numbers of cases in China and there was much uncertainty about the
85 potential impact of the virus on pregnancy, particularly in the early stages of the pandemic.
86 Previous coronavirus health crises due to Severe Acute Respiratory Distress Syndrome (SARS)
87 and Middle Eastern Respiratory Distress Syndrome (MERS) were associated with significant
88 morbidity including severe respiratory illness, increased Intensive Care Unit (ICU) admission
89 and mortality in pregnancy(3).

90

91 This pandemic has been dubbed an “info-demic”(4) and while the H1N1 pandemic of 2009
92 was the first of the internet age, social media plays an even greater role in the rapid spread
93 of information and at times misinformation about COVID-19. Perceived mixed messages from
94 public health officials can lead to confusion, uncertainty and fear(5). While studies have
95 shown that exposure to media or public health focused advertising during the H1N1 pandemic

96 had a positive impact on health knowledge and behaviours, the impact of social media
97 platforms such as Twitter and Facebook was not fully evaluated(6).

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99 “Lockdown” by which people were ordered to stay in their homes to reduce social contacts
100 and limit the spread of Covid -19 was a strategy adopted by many countries. Social isolation
101 can have profound effects on mental health and previous studies have identified women and
102 mothers of children under the age of 18 to be particularly vulnerable(7) . In times of disaster
103 women in the pre and postnatal period may experience higher rates of mood disorders than
104 the general public(8). Those with underlying mental health problems are at risk of post-
105 traumatic stress disorder(9). After the SARS health crisis an increase in avoidance behaviours,
106 absenteeism from work and excessive hand washing was observed(10).

107 While pregnancy is a happy time for many, it can be a time of heightened anxiety and
108 uncertainty(11). Our aim was to understand the lived experience of pregnancy during the
109 pandemic and the effects on the women’s home life and social support system as well as learn
110 from the effects that the hospital restrictions and measures had on women and their families
111 during extenuating circumstances.

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120 **Methods**

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122 The majority of the women participating in the study were attending the National Maternity
123 Hospital which is a tertiary level unit, one of three serving the city of Dublin. Approximately
124 9,000 births occur within in unit every year, providing care from midwifery led to high risk
125 multidisciplinary care.

126 The public health strategy in the management of the spread of COVID-19 in Ireland was
127 divided into stages which began with an initial containment phase in February 2020. The first
128 case of SARS-COV2 in the Republic of Ireland was detected on 29th February 2020. The World
129 Health Organisation declared a global pandemic on the 11th March 2020. Following this Ireland
130 entered a delayed phase of the pandemic with the announcement of closures of schools, third
131 level education and childcare facilities. As cases continued to rise, a “*Stay at home*” or
132 “*lockdown*” phase was announced on 27th March with non-essential businesses closing,
133 limitations on non-essential travel and outdoor exercise limited to within a 2km radius of
134 home. A gradual easing of restrictions was announced on 15th May. At the time of writing
135 some restrictions have remained in place and some have been reintroduced following an
136 increase in reported cases. At the peak of cases being reported in April and May, Ireland saw
137 a high case fatality rate compared to many other European countries(12). This was explained
138 by outbreaks in nursing homes and residential facilities affecting vulnerable groups. The
139 interviews for this study were conducted between April and July 2020, therefore during the
140 height of the first lockdown phase.

141 The aim of the study was to explore womens’ the experiences of accessing maternity care
142 while pandemic related restrictions were in place. A Straussian grounded theory approach
143 was employed. The work was based a large Dublin tertiary referral unit but was open to

144 include women from the other two Dublin maternity hospitals. These are stand-alone
145 maternity units providing a combination of consultant and midwifery lead care. Semi-
146 structured interviews were performed of women with different experiences of pregnancy
147 with sampling of groups in midwifery led care, pregnancy affected by diabetes, requirement
148 for long term admission, preterm birth, early pregnancy or postnatal women. Participants
149 were invited to participate in the study by posters and handouts in clinics, and on social
150 media. Recruitment started in April 2020 and ran until July 2020. Participants were given the
151 option of video or phone interview.

152 The interview guide (Appendix 1) based on the literature was developed by all the research
153 team members and modified as the interviews progressed allowing new hypotheses to be
154 tested. Our research team consisted of three obstetricians, one psychologist and one
155 academic midwife. None of the clinical staff interviewed women that they were directly
156 involved in caring for. As clinical members of the research team were involved in delivering
157 care during the pandemic and were involved in changes that the hospital made in order to
158 optimise that care,.

159 Data were analysed using the constant comparative method(13). Detailed notes were made
160 after each interview which allowed for interviews to be linked to analysis already performed.

161 After each interview was transcribed it was analysed which informed the development of
162 questions for the next interview. This was continued until theoretical saturation occurred.

163 One researcher (NK) reviewed all transcripts with at least one other member of the team
164 providing a second review. If discordance on categories was present, a discussion took place
165 between the researchers to reach consensus. to reduce the potential for bias it was critical
166 that the research team met after each interview was analysed in order to ensure rigor within
167 the process.

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Ethical considerations

Ethical approval was granted by the National Maternity Hospital Research Ethics Committee and this study was carried out in accordance with their guidelines. Due to the sensitive nature of the subject material, women who had experienced pregnancy loss during the pandemic were not included in this study. Women were provided with written information and informed consent was obtained from all participants prior to participation. All participants were aged over 18 at the time of interview. In order to ensure data security, interviews were carried out via secure, encrypted video conference or telephone call with digital recording. Recorded data was kept on a password protected computer in a locked office. During the transcription stage anonymisation was carried out by changing names and places of the data to remove any potentially identifying information. Once this was carried out, audio recordings were destroyed.

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194 **Results**

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196 **Participant characteristics**

197 Sixteen women contacted the research team expressing their interest and fourteen
198 consented to participate in the study and were interviewed. Demographic information is
199 shown in Table 1, with pregnancy details in Table 2. Two women elected to be interviewed
200 over the phone with the remaining eleven interviews being carried out by recorded video
201 conference. Three women requested copies of their interview transcripts but did not suggest
202 any changes to be made before or during analysis.

203

204 *Table 1. Participant Demographics*

205	Age (years)	n=
206	24-34	4
207	35-45	10
208	Parity	
209	Primiparous	9
210	Multiparous	5
211	Ethnicity	
212	White Irish	12
213	White British	2

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222 *Table 2 Participant details*

Participant number	Ethnicity	Time of interview	Antenatal/postnatal	History
1	White Irish	July	3 months postnatal	P0, emergency LSCS in labour for NRCTG
2	White Irish	July	3 months postnatal	P0, postnatal, SVD, Meconium aspiration, NICU admission for 2 weeks
3	White Irish	July	39 weeks	P1, previous SVD, interview 1 week before planned IOL
4	White Irish	July	13 weeks	P1- previous TOP for fetal anomaly, IVF cycle cancelled due to pandemic but conceived spontaneously
5	White Irish	July	3 months postnatal	Postnatal, baby underwent surgery for pyloric stenosis
6	White, UK	July	35 weeks	P0, partner is non-native English speaker
7	White Irish	July	28 weeks	P0, no medical history
8	White Irish	July	3 months postnatal	P1, previous difficult delivery, changed care to plan for homebirth at 37 weeks due to pandemic
9	White, UK	July	28 weeks	P0, Living in Ireland for one year, private antenatal care
10	White Irish	July	8 weeks post natal	P0, IVF pregnancy, severe PGP, SVD, private consultant lead care
11	White Irish	April	34 weeks	P0, same sex couple, IVF pregnancy
12	White Irish	May	21 weeks	P0, Clomid pregnancy, interview before anatomy

13	White Irish	June	2 weeks postnatal	Hx pre-term delivery, cervical cerclage at 14/40 delivered by SVD at term
14	White Irish	May	31 weeks	P0, gestational diabetes mellitus

223 Six categories were identified; loss of normality, navigating “new” maternity care systems,
 224 partners as bystanders, balancing information, uncertainty, and unexpected benefits of
 225 pregnancy during the pandemic. These are described in further detail below.

226

227 **Loss of normality**

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229 Women described the “*new normal*” of a pregnancy during a pandemic; “*it was different after*
 230 *the Covid stuff hit*”. The usual social element of pregnancy was gone as events such as baby
 231 showers were cancelled. Women found it difficult to engage with other pregnant women
 232 which added to a sense of isolation and there was less excitement surrounding the pregnancy
 233 . One women said “*It would have been nice to meet other mums who were due their baby at*
 234 *the same time. So all that social element was totally gone*”[P10]

235

236 The usual celebration of pregnancies with friends and family members was no longer possible
 237 due to restrictions. Women felt that they missed out on sharing their pregnancy with their
 238 family. This was especially difficult for women who had experienced fertility problems.
 239 Women described the impact on their families who were not able to see women and had to
 240 join their pregnancy through technology or seeing them through a glass window as a way of
 241 involving them in their pregnancy, with one woman in her first pregnancy describing how
 242 “*every week my family are like “aw send us a picture of your bump”*” P12

243 This was an isolating time for many women as they were cut off from their usual support
244 systems. One woman described the change to her visits to the antenatal clinic which became
245 an unpleasant experience. She felt women were nearly afraid to engage in conversation with
246 each other due to the threat of the virus, saying “ *in the waiting room there was always a
247 lovely atmosphere, it was gone after the Covid stuff hit*” P10

248

249 **Navigating “new” Maternity Care Systems “ you were made to feel there was nothing weird
250 going on outside the doors”**

251 Women had varying experiences of the changes in how care was delivered. One woman felt
252 safe coming to a stand-alone maternity hospital as it felt removed from the pandemic which
253 she associated with general hospitals. Some women had virtual or telephone consults which
254 they felt de-personalised the experience with one woman describing a phone consultation
255 with her obstetrician at 16 weeks as “*tokenistic*”. Face to face antenatal visits were limited
256 out to allow for reduced clinic size and social distancing in waiting rooms. One woman found
257 this increased her anxiety, as being in her first pregnancy, she felt she needed the reassurance
258 of a hospital visit.

259

260 Many hospitals changed to provide antenatal classes online. This was either pre-recorded or
261 virtual. One woman felt that doing pre-recorded classes took away from the experience as it
262 was less individualised, “*You can’t interact and you can’t ask anyone*” Participant 11

263 One woman, having experienced a crowded postnatal ward previously, changed to a planned
264 home birth at an advanced gestation due to fears about how the hospital would manage a
265 potential outbreak, saying “*Suddenly the risks of the home birth became less than having to
266 spend time in [hospital]*” P8

267 The three women who did experience hospital birth during the pandemic felt that the birth
268 experience itself was not negatively impacted by the restrictions, with one participant
269 describing the delivery room saying *“I don’t think there was any change in the room, the
270 midwives, anything like that. I didn’t feel I had any less care”* P2

271 Some hospitals expanded early transfer home services to reduce the capacity on the postnatal
272 ward which women found beneficial, *“I just find that was much better in a home setting than
273 in the hospital setting when there’s so much going on”* P1

274 One participant was directly affected by restrictions in NICU when her baby was unexpectedly
275 admitted with Meconium aspiration. For two weeks she was limited to spending 15 minutes
276 every day with her baby. Her partner was not permitted in to the NICU which added to the
277 stress of having an unwell baby, *“I didn’t feel like his mother... my whole day was spent waiting
278 for that 15 minutes”* P2

279 Not having the baby’s father present in the NICU added to concerns about how he would
280 bond with the infant but also the mother felt more isolated without the support of her partner
281 as an advocate or someone to ask questions on her behalf , *“I would have benefitted hugely
282 from having him being able to go to the NICU... He would have asked questions”* P2

283

284 **Partners as bystanders- “he..felt very disconnected from the whole process”**

285 One of the most distressing aspects of the change in care during the pandemic was the
286 restrictions on partners attending hospital visits. Anatomy scans were a particularly difficult
287 milestone for the partners to miss out on, especially for couples who had experienced
288 pregnancy loss previously. One woman described attending out of hours with reduced fetal
289 movements and found this experience particularly difficult to go through alone, *“It was just*

290 *really strange.. I had to go in on my own.. and ..I was worried that something had happened*
291 *to him [baby] and I had to go and sit in the waiting room by myself” P1*

292 While none of the hospitals prevented partners from attending the birth of their children, the
293 potential that tighter restrictions on partners caused a lot of anxiety. Women feared losing
294 their birth partner as an advocate while they were in labour and after the birth, *“I didn’t*
295 *experience the not having your partner there.. but my god it just terrifies me, the idea that I*
296 *wouldn’t have anybody that was on my side who knew me while being so very vulnerable*
297 *which you are in labour” P8*

298 Women described that by missing out on appointments he/she felt disconnected from the
299 process *“it was a team effort and I felt that had been taken away by having to go to the*
300 *appointments.. by myself” P10*

301 One women pointed out that partners were labelled as “visitors” when they should have been
302 given special status, *“It’s this whole thing of... seeing partners as visitors as opposed to*
303 *partners” Participant 6.* Many women could not understand the restrictions placed on
304 partners attending when they were often from the same household and felt they should have
305 been viewed as family unit rather than individuals as *“chances are your birth partner is a*
306 *member of your household” P3*

307

308 **Balancing information “the reality is it’s so new I don’t think people know”**

309 Many women felt that by keeping informed they would feel empowered but also appreciated
310 that having too much access to news could feel overwhelming. The sources of information
311 ranged from mainstream news and social media to peer reviewed medical journals. The lack
312 of up to date pregnancy specific information about the virus and its potential impact on
313 pregnancy was a source of anxiety, *“the reality is it’s so new I don’t think people know”.*

314 Women also feared for the health of their babies and also how they would manage to care
315 for other children if they were to become unwell. Two of the women from the UK relied on
316 the Royal College of Obstetrics and Gynaecology (RCOG) for up to date and reliable pregnancy
317 information. Of note there was no Irish equivalent as a single source for patient focused
318 pregnancy specific guidance. Women looked at hospital websites but this was often not their
319 primary source of information. The lack of relevant information meant that women were less
320 likely to trust their healthcare providers as a source as they realised that the medical
321 community was uncertain about the effects of SARS-COV2 in pregnancy, *“Initially they were*
322 *saying ‘no pregnant women aren’t any more high risk than anybody else’ but then.. the HSE*
323 *are saying to their own pregnant staff ‘you shouldn’t be working near coronavirus patients’ ”*

324 *P11*

325

326 Conflicting information was a source of anxiety for women, *“I’m getting different messages”*

327 *P4*

328

329 Some of the messaging and language used around restrictions by the hospitals were unclear
330 which caused stress amongst women, especially when information related to when their
331 partners would be able to attend with them to hospital, with one women saying *“the phrasing*
332 *used was.. your birth partner will be allowed in when you’re in active labour... like what does*
333 *that mean?” P10*

334

335 **Uncertainty “I acted as though I was a vulnerable person”**

336

337 Women received conflicting information about the potential impact of the virus on their
338 health. Many women felt vulnerable and chose to cocoon despite the HSE recommendation
339 that this was not necessary with one women saying *"We didn't have symptoms. We were
340 just pregnant, but we didn't have asthma ... or cystic fibrosis. We were just pregnant women.
341 And we were thinking, okay, so, [can] I still go on the Dart [commuter railway network] or
342 will I still go on the bus?" P11*

343

344 While the initial "lockdown" message was clear, the gradual easing of restrictions brought
345 new challenges, *"It's harder to know the right thing to do is...what is being responsible, what
346 is being paranoid" P9*

347

348 **Unexpected benefits "It was a bit of a blessing in disguise"**

349

350 Many of the participants highlighted unexpected benefits of the restrictions. Lockdown gave
351 many women the opportunity to work from home which made it easier to manage normal
352 pregnancy symptoms such as fatigue or nausea. The lack of commuting was seen as positive
353 and many women felt they had more time to devote to exercise or to spend with their
354 partners. This was also valuable after the birth as many women felt this extra time allowed
355 for bonding and there was no pressure to see people or bring their new baby out.

356

357 *"We brought him home and my plan was to ..lock the door, stay in... We definitely benefitted
358 from that." P1*

359

360 *"...not being overwhelmed with visitors. I'm quite glad that we can kind of have an excuse to*
361 *say to people 'actually, not at the moment' " P9*

362

363 Many women's partners were able to continue working from home after the birth which
364 allowed for additional support in the "fourth trimester".

365

366 The changes in the maternity care service had some benefits. Many women appreciated
367 quieter waiting rooms and benefitted from more community based care including early
368 transfer home teams. One woman described the positive milestones in her pregnancy which
369 gave her something to look forward to or a positive focus in uncertain times

370

371 *"I think.. one of the advantages to being pregnant.. is that you... feel like there's an end to it...
372 psychological end... my family and friends are like it's groundhog day and I'm like no it's not
373 because I've got a new milestone every week or a new thing to look forward to .. so that kind
374 of helps" P9*

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387 **Discussion**

388 The disruption and uncertainty that came with the pandemic at a time when women were
389 feeling particularly vulnerable caused great anxiety. While understandably a lot of initial
390 research into COVID-19 in pregnancy was on the physical effects, we are beginning to see the
391 psychological effects that isolation and prolonged restrictions is having on pre and postnatal
392 depression(14). In one study of perinatal anxiety, 60% of women reported moderate or severe
393 anxiety symptoms(15). In a study in Italy, which was the epicentre of the pandemic in Europe
394 in the early stages, women with a history of anxiety or depression were at a higher risk of
395 anxiety symptoms or post-traumatic stress disorder during “lockdown” than those
396 without(16).

397 Most women sought information as a coping strategy. Often this information came from
398 social media or their peers rather than from the hospital itself. When the government in
399 Ireland advised groups considered at risk to “cocoon”, pregnant women were not included on
400 this list, but they were in the UK; this caused confusion. In a study in China, 90% of women
401 questioned considered themselves vulnerable(17). A perceived risk of spread of infection
402 from birth and through breastfeeding lead to increased requests for planned Caesarean birth
403 and higher rates of bottle feeding(17). While there was no association between information
404 source and level of anxiety, we know that conflicting information in times of humanitarian
405 crises is associated with higher levels of stress(18). The adverse effects of maternal stress on
406 the fetus and on infant cognitive development are well documented(19-21).

407 One of the strategies adopted by maternity hospitals was to introduce less frequent antenatal
408 appointments and move some consultations to telephone consultation. While there is a role
409 for developing telemedicine it is important not to depersonalise care. There is a need for
410 enhanced online support(17) and greater investment to make use of available technologies
411 to enhance the antenatal experience for women.

412

413 The women in this study relied on their partners for emotional support. The perceived risk
414 that a birth partner would not be present for delivery was a huge source of anxiety. The
415 presence of a supportive birth partner is associated with favourable birth outcomes(22).

416 The World Health Organisation (WHO) have upheld that all pregnant women should have a
417 companion of their choice present during birth(23). In one study of the effects of COVID-19
418 on women's birth expectations, women with a history of mental health disorders expressed
419 greater concern for their partner's health highlighting the important role a partner can have
420 during the pregnancy, birth and postnatal period(24).

421 The strength of this study in the in depth interviews which took place at the height of
422 restrictions, offering a unique perspective on pregnancy in the pandemic. This study is limited
423 by the lack of ethnic diversity in the group interviewed and further research is needed on the
424 impact of the pandemic on minority groups.

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434 **Conclusion**

435 While differences in hospital infrastructure across the maternity units in Ireland means that
436 each hospital has had to individualise its approach to keep its patients safe in the pandemic,
437 there needs to be a clear unifying message so women do not lose faith in the service. This
438 should take the form of clear guidance for patients and their families from a professional body
439 such as the Royal College of Physicians in Ireland. Hospitals must be quick to embrace
440 technology as a way of getting clear messages across.

441

442 In reducing the number of visits a woman had to make to the hospital, the maternity care
443 service needs to replace this with interactive communication to ensure that women do not
444 feel abandoned by the service. While telemedicine is an appropriate alternative in some
445 settings, the “hands on “ physical care required in pregnancy cannot be replaced and must be
446 adapted in future to ensure that the focus of the maternity service continues to focus
447 primarily on the women it serves and the virus second. Any public health measures taken in
448 maternity services must be mindful of the important role the birth partner can play as an
449 emotional support person and advocate.

450

451 Going forward there is an opportunity to expand on community delivered care, particularly
452 for low risk women. There is an urgent need to improve mental health support to deal with
453 the potential long term sequelae this pandemic will have on our most vulnerable in society.

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459 **Abbreviations:**

461 *IVF (in vitro fertilisation) LSCS (lower segment caesarean section), NRCTG (non reassuring*
462 *cardiotocograph), NICU (neonatal intensive care unit) PO (primiparous woman); PGP (pelvic girdle pain))*
463 *SVD (spontaneous vaginal delivery) TOP (termination of pregnancy)*

464

465 **Declarations**

466 Ethics approval and consent to participate

467 This study was approved by the National Maternity Hospital Ethics Committee EC 14.2020

468

469 Consent for publication not applicable

470

471 Availability of data and materials

472 The anonymised qualitative data set, analysed during the current study, is available from the
473 corresponding author upon reasonable request.

474

475 Competing interests

476 The authors declare that they have no competing interests

477

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481

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485

486 Authorship

487 NK has made a substantial contribution to the conception and design of the work. The acquisition
488 analysis and interpretation of the data, has drafted the work and has approved the submitted version
489 and agrees to be both personally accountable for her contribution and to ensure that questions
490 related to the accuracy and integrity of any part of the work even ones in which the author was not
491 personally involved are appropriately investigated, resolved and the resolution is documented in the
492 literature.

493

494 BD has made a substantial contribution to the conception of the work, to the interpretation of the
495 data, has substantially revised it and has approved the submitted version and agrees to be both
496 personally accountable for his contribution and to ensure that questions related to the accuracy and
497 integrity of any part of the work even ones in which the author was not personally involved are
498 appropriately investigated, resolved and the resolution is documented in the literature.

499

500 SC has made a substantial contribution to the conception of the work, to the interpretation of the
501 data, has substantially revised it and has approved the submitted version and agrees to be both
502 personally accountable for her contribution and to ensure that questions related to the accuracy and
503 integrity of any part of the work even ones in which the author was not personally involved are
504 appropriately investigated, resolved and the resolution is documented in the literature.

505

506 JL has made a substantial contribution to the conception and design of the work, to the interpretation
507 of the data, has substantially revised it and has approved the submitted version and agrees to be both
508 personally accountable for her contribution and to ensure that questions related to the accuracy and
509 integrity of any part of the work even ones in which the author was not personally involved are
510 appropriately investigated, resolved and the resolution is documented in the literature.

511

512 MFH has made a substantial contribution to the conception and design of the work. The acquisition
513 analysis and interpretation of the data, has drafted the work and has approved the submitted version
514 and agrees to be both personally accountable for her contribution and to ensure that questions
515 related to the accuracy and integrity of any part of the work even ones in which the author was not
516 personally involved are appropriately investigated, resolved and the resolution is documented in the
517 literature.

518

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