



How does the use of continuous electronic fetal monitoring influence women's experiences of labour? A systematic integrative review of the literature from high income countries

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ABSTRACT

Background: A variety of technologies are used to monitor fetal wellbeing in labour. Different types of fetal monitoring devices impact women's experiences of labour and birth.

Aim: This review aims to understand how continuous electronic fetal monitoring (CEFM) influences women's experiences, with a focus on sense of control, active decision-making and mobility.

Methods: A systematic search of the literature was conducted. Findings from qualitative, quantitative and mixed methods studies were analysed to provide a review of current evidence.

Findings: Eighteen publications were included. The findings were synthesised into three themes: 'Feeling reassured versus anxious about the welfare of their baby', 'Feeling comfortable and free to be mobile versus feeling uncomfortable and restricted', and 'Feeling respected and empowered to make decisions versus feeling depersonalised with minimal control'. Women experienced discomfort and a lack of mobility as a result of some CEFM technologies. They often felt anxious and had mixed feelings about their baby's welfare whilst these were in use. Some women valued the data produced by CEFM technologies about the welfare of their baby. Many women experienced a sense of depersonalisation and lack of control whilst CEFM technologies were used.

Discussion: Fetal monitoring technologies influence women's experiences of labour both positively and negatively. Wireless devices were associated with the most positive response as they enabled greater freedom of movement.

Conclusion: The design of emerging fetal monitoring technologies should incorporate elements which foster freedom of movement, are comfortable and provide women with a sense of choice and control. The implementation of fetal monitoring that enables these elements should be prioritised by health professionals.

Statement of Significance

Problem or Issue: Fetal monitoring technology is used in almost all labour and birth settings. Women should have positive experiences with such technology. Health professionals and policy makers should know what elements contribute to more positive experiences so that these can be prioritised.

What is Already Known: Elements of the birth environment, including fetal monitoring technologies, affect women's experiences of labour and birth. Positive experiences of labour and birth contribute to increased post-natal health and wellbeing.

What this Paper Adds: This paper synthesises findings from 18 studies to summarise the elements of fetal monitoring which

contribute to more positive labour and birth experiences. CEFM evoked mixed feelings about fetal welfare. Wireless CEFM was associated with increased comfort, freedom of movement and feelings of control in comparison to wired CEFM.

Introduction

Experiences of labour are personal and distinct, encompassing a complex interplay of factors. Psychological experiences, in addition to obstetric outcomes, can have profound and long-lasting impacts on maternal health and wellbeing [1,2]. In many instances, interventions may influence women's overall psychological experience of labour and

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birth [3]. There is a growing body of research exploring how different forms of fetal heart rate monitoring technologies affect a woman's experience of labour and birth.

Fetal heart rate monitoring (FHM) is used to assess fetal welfare, particularly during the intra-partum period. In a hospital labour setting, the two main forms of FHM are intermittent auscultation (IA) and continuous electronic fetal monitoring (CEFM). IA involves the use of a Pinards stethoscope, handheld Doppler or portable ultrasound and is endorsed by international guidelines for women experiencing a healthy pregnancy with no identified risk factors for fetal hypoxia [4–7]. For women with identified risk factors, CEFM is suggested [6,8,9] despite the argument by some that there is a lack of evidence to support its use for women of any risk [10]. CEFM is commonly carried out via cardiotocograph (CTG) which employs ultrasound technology to continuously measure the fetal heart rate, coupled with a tocograph, or pressure monitor, which tracks uterine activity (contractions). These data are represented on a computer monitor and/or paper printout known as the CTG trace. The trace is interpreted by clinicians and is one element that contributes to the overall clinical picture when estimating fetal well-being and guiding decision making on whether obstetric intervention may be necessary.

In many instances, CTG transducers connect the woman to a machine via wiring, held in place by two elastic belts around her abdomen. In some facilities, wireless monitoring, also known as telemetry, is available, however when available, is not always used [11]. Where women are connected to a machine by wiring, they have less freedom of movement in labour [12]. The importance of freedom of movement and positioning in labour is well documented [5,13,14]. When women are able to move freely, they are more likely to experience a shorter labour, and less likely to undergo caesarean section or request an epidural [13, 14]. Furthermore, enabling freedom of movement aids women to intuitively move into positions that will optimise fetal positioning, reduce pain, promote more efficient uterine contractions [15–17], and also provides women with a sense of autonomy [18]. When women feel in control, endogenous oxytocin production is enhanced, while adrenaline and stress hormone production is simultaneously reduced, therefore optimising physiological labour processes [19,20].

An alternative to external CEFM is the fetal scalp electrode (FSE), which is attached to the fetal scalp, via the woman's vagina. Fetal electrocardiogram (ECG) is often more consistent and reliable than external CTG monitoring, however it is more invasive for both the woman and her baby [21].

The wireless and beltless non-invasive fetal electrocardiogram (NIFEKG) has emerged more recently. This device is applied to the woman's abdomen by an adhesive patch which involves minimal repositioning during labour. A pilot study in an Australian maternity setting found that the NIFEKG assisted women to move and position freely throughout labour and was well received by women and most clinicians [22]. As it remains a relatively novel device, more research is needed to determine its efficacy, reliability and acceptability among different populations.

This review aims to understand how the use of continuous electronic fetal monitoring influences women's experiences of labour. A systematic review published by Smith et al. in 2017 [23], examines this topic. In their review, Smith et al. examined ten papers published between 1976 and 2008 and identified four key themes pertaining to women's experiences of fetal monitoring in labour: discomfort, anxiety/fear, reassurance and communication [23]. EFM devices were a source of physical discomfort for women and a preference for wireless fetal monitoring devices was common, to allow greater mobility [23]. Auditory stimuli from FHR monitoring devices often evoked fear and anxiety, which increased when internal fetal monitoring devices were used [23]. However, women also felt reassured by the sound of their baby's heartbeat in labour [23]. Finally, they found that women perceived EFM devices as a barrier to effective communication between them and their caregivers [23].

Unlike Smith et al.'s 2017 paper, this review is limited to women's experiences of continuous electronic fetal monitoring in labour. We have chosen to include the studies already reviewed by Smith et al., as they present useful findings regarding women's experiences and are critical in shaping our overall analysis. In doing so, this review intends to provide a baseline to compare how emerging forms of fetal heart rate monitoring may influence women's experiences of labour.

Modern maternity care in high income countries has become heavily influenced by medical practices and procedures, leading to the medicalisation of childbirth [24]. In many instances, the medicalisation of childbirth often involves unnecessary intervention that offers little to no maternal or fetal benefit [10]. Since the introduction of CTG in the 1960 s, intrapartum use of CEFM has become commonplace. In the current Australian maternity landscape, some authors estimate that approximately half of women giving birth experience CEFM [22]. This indicates a need to understand women's experiences with CEFM to identify areas for improvement and implement changes to maximise women's experiences.

Methods

An integrative review of the literature exploring women's experiences of continuous electronic fetal monitoring during labour was conducted. The methodology outlined by Whittemore & Knafl [25], was used, including problem identification, a comprehensive search of the literature, evaluation of data, analysis of data and finally presentation of data. By conducting an integrative review, a diversity of methodology could be included, thus allowing for a more comprehensive examination of the data [25]. This design was chosen to present a comprehensive summary of the evidence regarding this topic. It enables confirmation of current practice and any variations, as well as identification of areas for improvement where future research may be required. Findings from this review will be used to guide the design and uptake of new fetal monitoring devices, such as the NiFEKG, in anticipation of increasing positive experiences and maternal and fetal outcomes where CEFM is used.

Inclusion and exclusion criteria

Qualitative, quantitative and mixed methods research was included. There were no restrictions on the date of publication. Inclusion and exclusion criteria are outlined in Table 1.

Search strategy

A systematic search of the literature was undertaken relating to women's experiences of intrapartum fetal monitoring, using the

Table 1
Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
– Peer reviewed literature about women's experiences of fetal monitoring during labour	– Literature reviews
– Qualitative or quantitative or mixed methods research	– Midwives' and/or medical practitioners' perspectives on fetal heart rate monitoring
– Published in English	– Pertaining to antenatal fetal monitoring
– Set in a high-income country	– Reporting incompatible with extrapolation of findings. For example, results reported not allowing insight into women's specific experiences
	– Data collected on women's general views towards labour and birth
	– Study setting in a low or low-middle income country, where access to fetal heart rate monitoring technologies is limited
	– Grey literature

following databases: CINAHL, Medline (OVID), Informit, Cochrane Library, Interim, Maternity and Infant Care, Pubmed, SCOPUS and Science Direct. Reference lists of identified publications were manually searched for additional relevant literature not identified via electronic search. Key search terms included the following: pregnant wom?n, wom?n, mother*, labo?r, intrapartum, intra-partum, continuous electronic fetal monitor*, cEFM, electronic fetal monitor*, cardiograph*, experience*, attitude*, perspective*.

Search results

Of the nine databases searched, a total of 247 records were identified from the initial search. Of those, 13 duplicate records were removed. The titles and abstracts of the remaining 234 articles were then screened by two authors and 203 of these were excluded as they were deemed irrelevant. Thirty-one full text articles were assessed for eligibility by the same authors and 25 were excluded based on either the wrong population, intervention, setting, study design or outcomes. Thus, from database searching, six studies were deemed appropriate to include in this review. A further 46 articles were identified from hand searching of reference lists, of which 12 articles were identified as appropriate to include in this review (See Fig. 1). We assume that this large number of articles were not identified through the initial search as some were not available on the databases searched and had to be obtained via an alternative institution. Further, all of these articles were published prior to 1985, which may have impacted their availability through the initial search. In total, 18 articles were identified and agreed on by all authors to be included in this review including four qualitative studies, six quantitative studies and eight mixed methods studies.

Analysis

The quality of each article was assessed with the Critical Skills Appraisal Programme (CASP) tools and the Appraisal tool for Cross-Sectional Studies (AXIS), none were excluded based on quality. All authors participated in the quality appraisal process. Data were extracted into tables including aim, study design, sample population, methods, data analysis and findings.

Findings

A thorough search of the literature found 18 articles published between 1976 and 2023, across six countries, that were included in this review. Table 2 outlines a summary of the articles identified to be included in this review.

After initial summation of the data, descriptive quotations were extracted, and a visual framework was developed (see Fig. 2). Using an interpretive approach, the findings from each of the articles were categorised into three themes:

Theme 1 'Feeling reassured versus anxious about the welfare of their baby'

Theme 2 'Feeling comfortable and free to be mobile versus feeling uncomfortable and restricted'

Theme 3 'Feeling respected and empowered to make decisions versus feeling depersonalised with minimal control'

Each theme is dichotomous in nature, as women gave opposing reflections of their experiences of using the fetal monitoring technologies. Ultimately, when women felt reassured, comfortable, respected and able to move freely, they were more likely to report positive experiences. However, when they felt uncomfortable, depersonalised and restricted in their movement, their experience was negative. This is reflected in the visual framework outlined in Fig. 2.

Theme 1. Feeling reassured versus anxious about the welfare of their baby

The literature identified the conflicting notions of reassurance versus anxiety women felt whilst CEFM devices were in use. CEFM was often a source of reassurance for women, with many describing feelings of comfort, safety and security [27–29,31,33,35,37–43]. For other women, use of CEFM devices was a source of anxiety throughout their labour as they described feelings of fear, nervousness and concern [27–29,35,36,38,40,42,43].

It was common for women to feel reassured about their baby's welfare when any type of fetal monitoring device was used, particularly CEFM. In fact, women described feeling an increased sense of safety for their baby because they believed the CEFM would immediately detect any sign of adverse fetal welfare [28,38,40,41,43]. Starkman [43] found

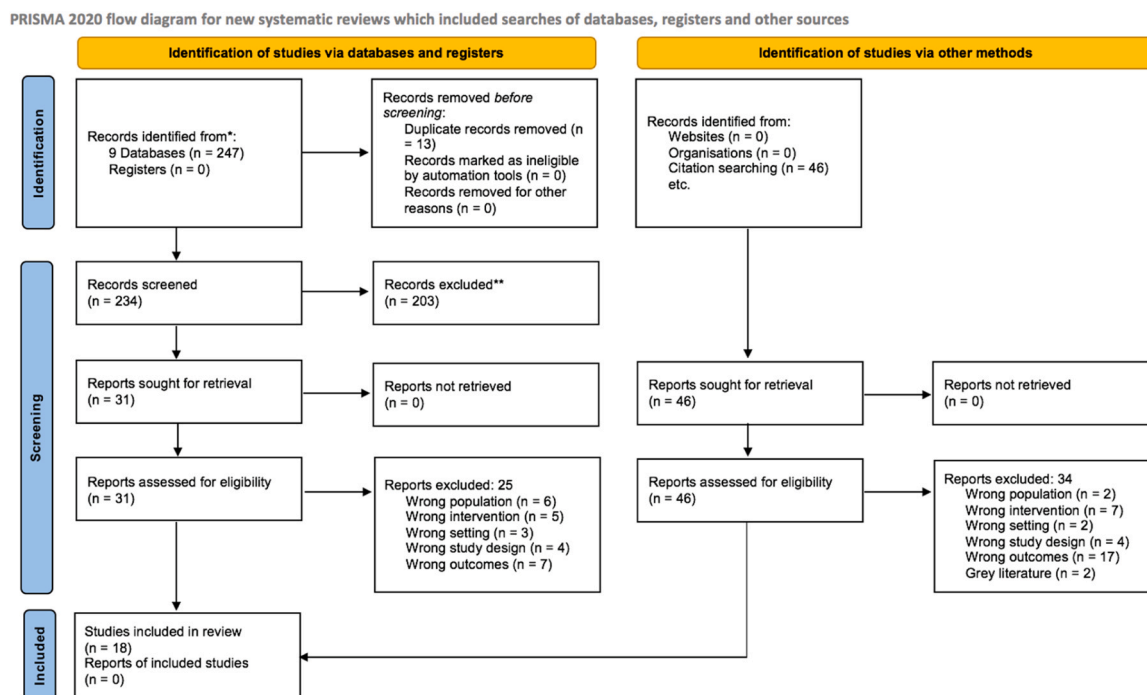


Fig. 1. PRISMA diagram of systematic review process. (Adapted from Page et al [26]).

Table 2
Summary of articles identified.

Author, year and location	Aim	Study design and population	Methods	Data Analysis	Findings
Barber et al. [27] 2013 England	To examine the effects of EFM technologies on women's anxiety.	Mixed methods sub-study (INFANT Study) N = 469 women	Visual Analogue Scale-Anxiety (VAS-A) measured anxiety levels at three time points (two during labour and one post-partum). 18 women were interviewed about their experience of monitoring and birth.	Descriptive thematic and framework analysis, repeated measures analysis of covariance, Pearson's correlation coefficient, Two-sided significance tests	Women found reassurance and comfort in the continuous monitoring of the fetal heart rate, but also noted anxiety in relation to the device. Others noted feeling restricted in their movement and positioning as a result of the CTG.
Beck [28] 1980 USA	To determine women's responses to fetal monitoring in labour.	Mixed methods study N = 50 women	Women were interviewed 1–3 -days post-partum about their initial and subsequent responses to FM in labour.	Descriptive analysis, chi-square	An equal number of women had positive and negative initial responses to the fetal monitoring device (CTG). Positive responses included feeling reassured and safe. Negative responses included feeling frightened and afraid, restricted and uncomfortable.
Benton et al. [29]. 2020 Australia	To examine women's experiences of intrapartum fetal monitoring in the START trial.	Qualitative sub-study of the START trial N = 32 women	Semi-structured interviews were conducted at 7–24 weeks post-partum exploring women's experiences with intrapartum fetal monitoring.	Descriptive thematic analysis	More positive experiences with FSEs than with CTGs, feeling reassured by monitoring was a dominant theme. Feeling stress related to belt mounted CTGs: restricted movement, and discomfort. FSE described as more reliable and aiding mobility but uncomfortable to apply.
Coddington et al. [30]. 2023 Australia	To explore women's experiences of wearing the NIFEKG in labour.	Qualitative sub-study of clinical trial N = 15 women	Qualitative, descriptive approach, interviews were conducted with women within 12 weeks of giving birth.	Descriptive thematic analysis	Women found the NIFEKG aided freedom of movement and active participation in labour.
Dulock and Herron [31] 1976 USA	To explore women's knowledge of fetal monitoring antenatally, and their attitudes after experiencing it.	Mixed methods study N = 71 (questionnaire) N = 31 interviews	Antenatal questionnaire exploring women's knowledge of fetal monitoring (N = 71) within one month of estimated due date. Interviews with 31 women post-partum to explore their labour monitoring.	Descriptive analysis, frequency counts	Initial reactions to fetal monitoring device: curiosity and fear, and security for some women. Following an explanation, feelings of security increased, and curiosity and fear decreased. Post-partum interview: Positive-greater sense of control from seeing the contractions on the monitor, and reassurance from hearing the fetal heart rate. Negative-discomfort and restricted movement.
Garcia et al. [32]. 1985 Ireland	To explore the experiences of women who received EFM vs IA in labour.	Quantitative sub-study of an RCT N = 200 100 women had EFM 100 women had IA	A semi-structured questionnaire in an interview format in postpartum period in hospital.	Chi-square, t-test	Women monitored with EFM felt more restricted in their movements, and were more likely to be left alone, compared to women monitored by IA. No statistically significant differences in the degree of control or anxiety between EFM and IA groups. Most women reported some level of reassurance, regardless of monitoring method.
Hansen et al. [33]. 1985 Denmark	To explore women's attitudes towards different types of FM.	Qualitative descriptive study N = 655 women had antenatal interviews re fetal monitoring preference. N = 385 were interviewed postpartum about their attitudes towards the type of monitoring they experienced.	Semi-structured interviews on day 2–3 post-partum of experiences and attitudes towards the type of monitoring they experienced during labour.	Descriptive analysis	Women monitored with IA mentioned no risk of infection, no pain to the baby, no discomfort from the sensors or belts and 'more natural childbirth'. The only major disadvantage of IA was insecurity as the heart rate is not continuously monitored. Women monitored with EFM mentioned reassurance, continuous precise surveillance, promotion of husband involvement and the possibility of quick intervention. Disadvantages included immobility, signal dropouts and fear of trauma to the baby.
Hindley et al. [34]. 2008 England	To investigate women's views on intrapartum fetal monitoring techniques and informed choice.	Quantitative (N = 63) Postnatal survey (N = 38)	Questionnaires adapted from a validated tool measuring informed choice specific to fetal monitoring. Women were asked about their knowledge and preferences for FM in the antenatal questionnaire.	Descriptive analysis, frequency counts, cross-tabulations	Antenatal survey: most women wanted to receive EFM in labour. Post-natal survey: most women reported they did not have a choice in the method of intrapartum FM, 38% of women conceded decision-making powers to the midwives,

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Table 2 (continued)

Author, year and location	Aim	Study design and population	Methods	Data Analysis	Findings
Hodnett [35] 1982 Canada	To explore the extent women maintained a sense of control during labour, comparing two different types of FM.	Mixed methods study N = 30 women	In the post-natal questionnaire, they were asked about their preferences for monitoring in labour and monitoring outcomes. Within 48 hours of birth, women completed the Labour Agency Scale. All women had a semi-structured interview focused on labour expectations and attitudes towards FM.	Descriptive analysis, student's t-test, Fishers exact test, chi-square	and identified IA as important due freedom of movement and positioning in labour. Women who received wireless CTG: spent more time out of bed, felt reassured and free to move, were more satisfied with their labour and reported higher sense of control - thus scoring higher on the LAS. Women who received wired CTG: scored lower on the LAS and found the labour less satisfying than anticipated.
Jackson et al. [36]. 1983 England	To assess the reactions of women to continuous fetal heart rate monitoring.	Quantitative study N = 30	One day post-partum: verbal administration of a questionnaire. The women rated aspects of FM on a scale of reassurance.	Kruskal Wallis analysis of variance by Ranks tests.	Women were reassured from hearing the fetal heart, however variation in the fetal heart rate produced anxiety. The majority of women felt well informed about the monitor.
Kruse [37] 1984 USA	To explore women's long-lasting attitudes towards fetal monitoring.	Quantitative study N = 75	A questionnaire was sent to women 2-5 months postpartum which included 24 statements on a Likert scale about fetal monitoring.	Mean scores, Z-tests, factor analysis.	Women remembered the fetal monitor as an important provider of information and reassurance. They did not remember the monitor as an invader of privacy. 20% of women felt the monitor was uncomfortable or distracting and 24% felt it restricted their movement.
McDonough et al. [38]. 1981 USA	To understand women's reactions to fetal monitoring.	Mixed methods study N = 50	On the first day post-partum, women completed a questionnaire and interview regarding how well they were prepared for monitoring and what were their physical and psychological experiences were.	Descriptive analysis, frequency counts	Women had reactions of both reassurance from hearing the FHR, as well as fear when variations in the FHR. For some women, external FM was uncomfortable during labour, whilst internal monitoring fostered greater freedom to move and position. Women felt more comfortable with the machine when it was explained to them.
McMahon et al. [39]. 2019 Ireland	To explore women's views of fetal monitoring in labour.	Quantitative prospective study N = 48	Women were asked to complete a questionnaire about their FM experiences.	Descriptive analysis, frequency counts	The majority of women felt reassured as a result of having CTG monitoring in labour. Women were also highly satisfied with the communication about CTG monitoring from staff and felt included in decision-making.
Molfese [40] 1982 USA	To examine women's reactions to intra-partum FM.	A mixed-methods study N = 180 women 100 women from a community hospital 80 women from university medical centre	180 women participated in semi-structured interviews about their FM experiences. They also completed a questionnaire containing 61 statements.	Descriptive analysis, means and standard deviations, factor analysis	Most women had positive reactions to the fetal monitor. They mostly felt they understood the monitoring, felt reassured by the monitor and felt the monitor helped them deal with labour. Some women experienced malfunctions with the monitor, which was frustrating and they complained the straps were uncomfortable.
Parisaei et al. [41]. 2011 England	To assess the acceptability of STan monitoring systems among women.	Quantitative prospective questionnaire N = 77	Questionnaire for women who had STAN fetal monitoring in labour. This was completed post-partum (most on day 1).	Frequency counts, hypothesis tests, means, medians	The majority of women felt the reasons for being monitored were adequately explained, felt reassured by the method of monitoring and would be happy to be monitored in the same way again. Women found STAN monitoring an acceptable method of monitoring.
Shields [42] 1978 USA	To explore women's experiences with and reactions to fetal monitoring.	Mixed methods study N = 30 women	Semi-structured interviews within 48hrs post-partum and a questionnaire named the 'Mood and Feelings Inventory'.	Descriptive analysis, chi-square	22 women had mostly positive experiences, whilst 8 women had mostly negative experiences. Positive experiences: feeling reassured about the baby's wellbeing and having a good understanding of the monitor. Negative aspects: fear of the monitor harming the baby, feeling uncomfortable during monitoring, too many people present in the

(continued on next page)

Table 2 (continued)

Author, year and location	Aim	Study design and population	Methods	Data Analysis	Findings
Starkman [43]. 2022 USA	To investigate the psychological effects of fetal monitoring during labour.	Qualitative study N = 25 women	Structured interviews were conducted 1–7 days post-partum whilst the women were still admitted to hospital.	Descriptive analysis, Fisher exact probabilities test, Student's t-test	room, worrying about heart rate variations, receiving too little study information about the monitor, and depersonalisation. The monitor was seen as a protector and agent of reassurance, a provider of information when the woman felt unable to communicate appropriately, an extension of the baby confirming the baby was well and an aid in managing contractions. Women also felt negatively towards the monitor because it sometimes took the attention away from them, was uncomfortable, restricted their movement and it increased their anxiety regarding their baby's wellbeing.
Watson et al. [44]. 2022 England	To investigate the experiences of women and midwives using wireless continuous electronic fetal monitoring.	Convergent parallel mixed methods study using a pragmatic approach. Quantitative phase: 161 women Qualitative phase: 10 women, 2 partners and 10 midwives	Qualitative aspect of the study: grounded theory was used for one-on-one in-depth interviews exploring women's experiences of wireless cEFM in labour. Quantitative aspect of the study: validated Likert scale in the form of a questionnaire. This measured perceived control and satisfaction with their experience. Data collection within 8 weeks post-partum.	Descriptive analysis, aggregate and mean scores, t-test	Women using wireless FM were more mobile and positioned more freely during labour. This led to increased feelings of control, autonomy, normality and dignity.

Abbreviations: CTG: cardiocotograph; EFM: electronic fetal monitoring; FHR: fetal heart rate; FM: Fetal monitoring; IA: intermittent auscultation.

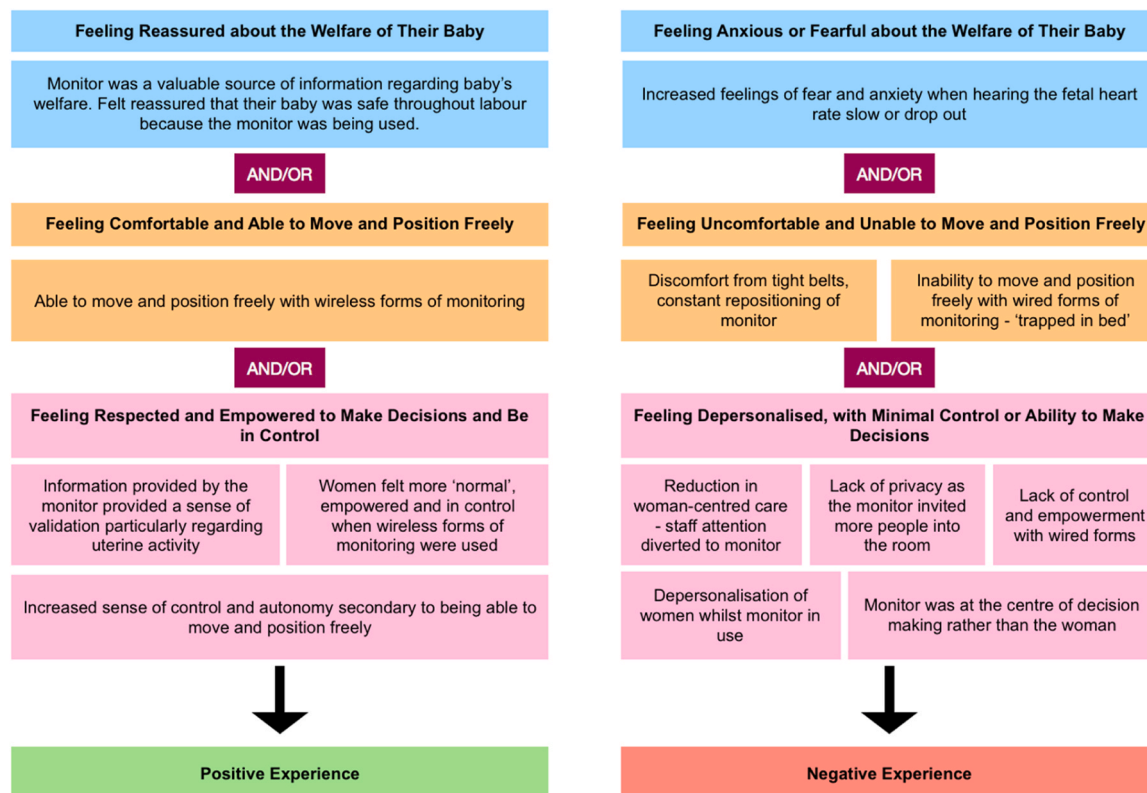


Fig. 2. Visual Framework of Findings.

that women perceived the CEFM as a ‘protector’, which provided reassurance - particularly when the doctor was absent from the room. Studies also described the reassurance CEFM provided to women who had a previous stillbirth, as they felt particularly comforted by the sound of their baby’s heartbeat during labour [33,43]. In a similar vein, [28] when CTG was in use, women often felt they were able to relax and not worry about their baby because it was like a “safe-guard” [28(p352)]. This is corroborated by the findings of multiple other studies, as women reported feeling relaxed and reassured of their baby’s welfare when either a CTG or FSE was in use [29,31,33,37–39,41,42].

Conversely, it was also found that the use of CEFM evoked fear and anxiety in some labouring women [27–29,32,35,36,38,40,42,43]. Women felt anxious when the fetal heart rate audibly slowed, or when the CEFM device lost contact and the fetal heart sounds dropped out altogether. Beck’s study [28] exploring women’s experiences with CTG monitoring described the device as a “monster” [28(p352)], making women feel nervous, fearful and anxious about the welfare of their baby. Similarly, Barber et al [27]. discussed the notion of fear and anxiety related to CTG drop out or maternal heart rate confusion as well as urgent staff reactions to the CTG monitor. This was a common experience with CEFM devices, as women recounted feeling worried about variations in the fetal heart rate, diverting their attention away from managing the pain of labour [27–29,32,35,36,38,40,42,43]. Furthermore, across the studies, some women voiced concerns about the CEFM device being directly harmful to the baby [29,38,42,43]. In particular, women described feelings of guilt when FSE was in use due to its invasive nature where the electrode is inserted into the fetal scalp.

Theme 2. Feeling comfortable and free to be mobile versus feeling uncomfortable and restricted

Maternal freedom of movement and positioning in labour, as well as feelings of comfort (or discomfort) were key themes in 16 of the 18 included studies. Wired forms of CEFM were predominantly associated with feelings of discomfort, restricted movement and positioning and disruption to labour [27–29,31–33,35,37,38,40,42–44]. When compared to wired CTG, wireless forms of monitoring were mostly associated with increased freedom of movement and mobility [30, 33–35,44].

Discomfort associated with CEFM devices was largely due to tight elastic belts, re-adjustment of the device by a clinician, immobility, leading to increased pain sensation and interrupted mindset. Eight of the studies found that the elastic belts used to hold the CTG transducers in place were a source of discomfort [27–29,31,32,35,37,40], as women described the belts as “uncomfortable” [29(p6)], “too tight” [31(p69s)], and “frustrating” [29(p5)].

Placement and adjustment of CEFM devices was also described as uncomfortable and disruptive for women [27,29,38,40,42,43]. Wired CTGs involved ongoing adjustment to ensure accurate tracing of the fetal heart rate, which was a source of frustration for women [27,29]. Similarly, where a fetal scalp electrode was used, women described the placement of these devices as “uncomfortable” [29(p6)] and even “traumatic” [29(p5)]. The FSE wire hanging between the woman’s legs was also uncomfortable [43]. Whilst women enjoyed the mobility afforded by the non-invasive electrocardiogram (NIFECG), they felt like they were being ‘poked and prodded’ by staff who were troubleshooting technical difficulties with the device and ensuring proper application [30].

Another common finding was the restricted movement women perceived when CEFM devices were in use [27–29,31–33,35,37,43,44]. This was most commonly described where wired forms of CTG were used. Where wired CTG was used, women felt they had limited freedom of movement, often disrupting their plans for an active labour [27]. Women described feeling “tied down”, [28(p352)] “hooked up”, [44 (p248)] “stuck”, [29(p5)] “attached” [44(p249)], and “tied to the bed” [44(p248)]. This had direct consequences for their uptake of

pharmacological pain relief, as well as negatively impacting their mindset in labour [27,29,31]. Barber et al. [27] found that where wired CTG monitoring was used, women had to stay in one position or hold the transducers in place themselves, to aid consistent fetal heart rate readings. Dulock & Herron, [31] Kruse, [37] and Starkman [43] all echoed this sentiment, as women felt confined and unable to move freely as a result of wired CTG. This resulted in women feeling heightened pain sensation secondary to immobility. [27,28,31] Furthermore, women felt distracted by the use and adjustment of CEFM, [37] and their overall mindset in labour was disrupted as a result of constant adjustment of the CTG. [29] Conversely, women felt that the cognitive information provided by CEFM devices helped them remain in control of the pain. Being able to see when contractions were building helped them to appropriately adjust their mindset, regulate their breathing and stay in control. [27–29,31,35,43]

Women commented on the sense of comfort and increased freedom of movement associated with wireless CEFM devices [30,33–35,38,44]. Beltless approaches [30,38] generating the CTG gave women greater freedom of movement than those using belts to hold the sensors in place. Women who used wireless CTG (telemetry) spent more time off the bed in labour, in comparison to those who used wired CTG, and were able to move and position freely. Women described a sense of normality as a result of being mobile with minimal restrictions in labour. [44]

Theme 3. Feeling respected and empowered to make decisions versus feeling depersonalised with minimal control

CEFM devices had the capacity to impact upon women feeling respected, empowered and in control during labour. Women were more likely to feel empowered and in control where wireless forms of CEFM were used, rather than wired CEFM [29,30,35,44].

The use of the FSE afforded women a greater sense of control due to its heightened accuracy [29]. Women reported feeling able to “do whatever you wanted to” [29(p5)] when the FSE was in use because it was re-adjusted less in comparison to CTG. Compared to wired forms, wireless forms of CTG were associated with increased levels of perceived control. [35,44] Where the beltless NIFECG was used, women reported feeling in control and able to actively participate in their labour, leading to a greater sense of bodily autonomy that was key to managing their pain in labour. [30] Utilising the Labour Agency Scale, Hodnett [35] found that women who received wireless forms of CTG monitoring experienced greater levels of control in comparison to women who received wired forms and that women who received wireless CTG found their labour more satisfying than expected and were proud to have maintained control. [35]

Wired CEFM led to feelings of lack of control, restriction and vulnerability. However, where wireless CEFM was used, women felt they had increased control and ownership of the birth space which led to feelings of empowerment and enabled active decision making [44]. Women described feeling less like a ‘patient’ and more like an ‘equal’ when they used wireless CEFM [44]. When women could freely move and access the bathroom without needing assistance, this led to a sense of normality and assisted them to feel respected and dignified in labour. This notion of access to the bathroom was also described as ‘bodily autonomy’ [44].

CEFM reduced personal care, disturbed women’s privacy and led to a sense of depersonalisation [27,31,32,38,40–43]. Women commonly described feeling a lack of privacy when CEFM devices were in use, as their function invited more people into the room [42,43]. Women reacted negatively to this, describing feelings of frustration when multiple people came into the room, often leaving the door open to read the monitors and fix technical difficulties [43]. Similarly, women felt the attention of health care providers was often diverted away from the women and towards the monitor [27,32]. In one study, a woman remarked that she would prefer someone to talk to her and reassure her as opposed to “writing down and checking the monitors” [27(p402)].

Garcia et al. [32] found that women who received CEFM in labour were more likely to be left alone, which they perceived negatively. In addition, women described feeling depersonalised as a result of CEFM [38, 42] using phrases like a “battery being charged with all those wires” [42 (p2111)]. Women’s decision-making ability was also compromised by CEFM [34] as they felt they did not have a chance to contribute to the choice of which fetal monitoring device would be used. In fact, in some cases, women felt like it was the monitor itself that made decisions for them [43].

Evidence from the literature pertaining to each theme can be found in [Supplementary Information](#) – Table 3.

Discussion

International research spanning decades has shown that women have a range of reactions to CEFM devices in labour, both positive and negative. Women were more likely to have positive experiences with CEFM devices when they felt reassured, able to move freely, in control, respected and empowered. This was often the case when wireless CEFM was used. Negative experiences stemmed from women’s anxiety and fear related to CEFM, being restricted in their movement and when they felt they had surrendered their control and decision-making powers. This was more often the case when wired CEFM devices were used.

Whilst the literature reviewed revealed much about women’s experiences with fetal monitoring devices, many of the articles included were published prior to 2000, with only 6 published after 2010. This emphasises the gap in the literature, as data from recent years is limited. Certainly, the birthing context has evolved since the 1970 s, exhibiting a paradigm shift towards a more woman-centred approach. At the same time, new technologies are entering the birth room which may significantly impact women’s experiences of labour and birth. In today’s context, where technology is omnipresent, women are unlikely to be disconcerted by the presence of technology in the birth space. This may contrast attitudes in the 1970 s and 1980 s where technology was far less prevalent. In addition, modern maternity care has become increasingly medicalised. This may contribute to expectations that birth will be managed, which can subsequently affect how women perceive their role in their own labour and birth. The data is therefore at risk of being outdated, as women’s views have arguably changed over time and women are likely to have different experiences now in comparison to those up to 50 years ago.

This review was consistent with the findings of Smith et al [23], whereby women often felt reassured by the sound of the fetal heart rate, emitted by CEFM devices. Whilst women expressed feeling reassured by consistently hearing their baby’s heartbeat throughout labour, CEFM offers minimal fetal benefit over intermittent auscultation [12]. In their 2017 Cochrane review, Alfirevic et al. found that in comparison to intermittent auscultation, continuous CTG showed no significant improvement in perinatal death rate and was associated with an increase in instrumental vaginal birth and caesarean section [12]. Therefore, despite the psychological benefit for women, we should consider that in some cases, CEFM also offers false reassurance and/or false alarm.

Health care providers should provide women with evidence-based information to inform decision making through the provision of antenatal education about the risks and benefits of various forms of fetal monitoring devices. A key finding across the literature was that women felt fearful and anxious when hearing fetal heart rate variations and loss of contact resulting in audio dropouts. In many instances, this may occur due to signal interference or maternal heart rate coincidence and is not necessarily confirmation of adverse fetal welfare. Explaining such instances to women may help reduce their associated fear and anxiety. In addition, providing education to women on the types of fetal monitoring technologies and what to expect from each may contribute to enhanced feelings of choice and control in labour and birth.

Despite the finding that positive experiences with CEFM were more common when wireless technologies were used, many women are still

not provided with access to wireless CEFM. A study conducted in Australia in New Zealand [11] found that where wireless continuous electronic fetal monitoring was available, access remained limited: “Forty-three percent ($N = 54$) of participants stated that while wireless or beltless monitoring was available at their facility it was used by less than half of the women that require continuous foetal monitoring” [11(p4)]. Thus, maternity service providers should actively ensure that women are able to access wireless fetal monitoring devices. This may involve support from external bodies, such as government, to ensure adequate funding to assist with the implementation of such devices. Further research is underway to explore how one particular form of wireless CEFM, the NIFECCG, may be best implemented in Australian hospitals, which may allow midwives to prioritise this type of CEFM for women.

Strengths and limitations

A strength of this paper is that it includes six additional papers published since 2008, therefore not included in the Smith et al. review. Since 2008, significant technological developments have occurred that warrant investigation from the perspective of women’s experiences. With the advent of external electrocardiograph monitoring since 2018, it is a timely opportunity to review current technologies and the impact on women’s experiences. A limitation of this review is that many of the articles were published prior to the development of wireless monitoring, hence researching a limited range of monitoring types.

The authors acknowledge that as midwives who support physiological processes in labour and birth, we advocate for fetal monitoring that enables freedom of movement and positioning. This is due to the evidence described in the background demonstrating that freedom of movement improves outcomes for women and babies [5,13–20].

Conclusion

The use of fetal monitoring technologies has a significant impact on how women experience labour and birth. A range of views and experiences was found in this study. For some women, CEFM provides relief to their concerns about the welfare of their baby, whilst for others it serves to increase anxiety about fetal wellbeing. In both cases, it is clear that CEFM devices that restrict women’s freedom of movement negatively impacts their labour, compromising their comfort, bodily autonomy and ability to cope with the pain of labour. In order to increase positive experiences, the design of emerging fetal monitoring technologies should incorporate elements which foster freedom of movement, are comfortable and provide women with a sense of choice and control. Midwives and other health professionals should prioritise the use of technologies that enable those elements.

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Ethical statement

No ethics approval was required for this study.

CRediT authorship contribution statement

Sarah Murray: Conceptualisation, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Deborah J. Fox:** Conceptualisation, Supervision, Writing – review & editing. **Rebecca L. Coddington:** Conceptualisation, Supervision, Writing – review & editing. **Vanessa L. Scarf:** Conceptualisation, Supervision, Writing – review & editing.

Conflict of interest

There is no conflict of interest to declare.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.wombi.2024.101619](https://doi.org/10.1016/j.wombi.2024.101619).

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