

**Personal Use of Handheld Fetal Doppler Monitors by Women in New Zealand**

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## Abstract

This qualitative descriptive study explores what factors are driving women in New Zealand to use handheld fetal Doppler monitors during their pregnancy. This is a little explored phenomenon in the literature, and consensus among health professional bodies is that pregnant women should be discouraged from using a handheld fetal Doppler. One concern health professionals hold is that a pregnant woman may be falsely reassured about the condition of her unborn baby and would delay presentation to her lead maternity carer, culminating in stillbirth or neonatal morbidity and mortality that potentially could have been avoided.

Six women from a major New Zealand city who were between 20- and 39-weeks' gestation participated in semi-structured interviews. Thematic analysis, as described by Braun and Clarke, was used to generate five main themes and six subthemes. *Control* was a strong overarching theme with subthemes of *Fertility and Pregnancy Loss*, *Ultrasound* and *Doppler anxieties*. *Fetal feedback* with the subtheme of *Bonding* was another strong theme. The third and fourth themes were *Peer-to-peer education and support* and *Lay knowledge versus professional knowledge* with a subtheme of *Lack of research*. The final theme was the *Woman-Midwife relationship* with a subtheme of *More support*.

Women's reasons for using a handheld fetal Doppler is for control of their response to the potential of miscarriage. This response is largely one of anxiety, particularly prior to the quickening of the fetus when there is little feedback to prove ongoing fetal life outside of symptoms such as morning sickness. Whilst women gain their information to underpin use of a handheld fetal Doppler via their peer groups in online forums and other internet-based repositories, they are wanting to enact partnership and shared decision-making with their lead maternity carer (LMC) regarding their use of handheld fetal Doppler monitors in pregnancy.

As technologies advance and become more available to non-health professionals, further exploration of use of handheld fetal Doppler monitors by pregnant women is needed in order to better inform women and midwives around the potential benefits and risks.

**Keywords:** handheld fetal Doppler, fetal heart rate monitoring, pregnancy, technology, control, informed choice, midwifery, qualitative descriptive methodology, thematic analysis

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# Chapter 1: Introduction

## 1.1 Background

A handheld fetal Doppler, also known by a brand name as a sonicaid, is a device that utilises continuous wave ultrasound in order to auscultate a fetal heart rate during pregnancy, with the sound produced digitally via an in-built speaker or via headphone attachment. These sounds are the reflection and amplification of the sounds of the fetal heart walls and valves as they move (Maude, 2019). This is the Doppler Effect, where sound pitch changes in response to the source of the sound moving, as hypothesised by Austrian mathematician Christian Doppler in the 1840s (Uppal & Mogra, 2010). An example of this effect is the change in pitch a siren on an emergency vehicle makes as it passes by a person standing stationary. Handheld Doppler monitors contain “two piezoelectric crystal elements (one for transmission and one for signal reception) aligned at an angle to each other, in the same transducer casing”, which produce a continuous wave ultrasound to generate sound from the velocity of blood flow detected under the area of the transducer probe (Uppal & Mogra, 2010, p.33).



*Figure 1: A type of handheld fetal Doppler used by midwives.*

*This type is not designed to display the fetal heart rate. Source: L.A. Honeyman*

The use of handheld Doppler monitors (Figure 1) in antenatal settings has become a routine part of the examination as the fetal heart can be auscultated at an earlier gestation compared to a Pinard stethoscope, prior to 28 weeks' gestation, and it allows for the woman and her support

people to hear the fetal heart via the inbuilt speaker of the device (Johnson & Taylor, 2005). Current advice from the National Institute for Health and Care Excellence (NICE) in the United Kingdom, however, suggests that auscultation of the fetal heart in a routine antenatal consultation in the context of an uncomplicated pregnancy does not provide any predictive value beyond reassuring the woman that her fetus is alive, and currently does not recommend routine auscultation (NICE, 2019). Grigg acknowledges the NICE recommendations, but argues that routine auscultation of the fetal heart has “profound clinical and personal meaning and value for pregnant women and their families”, particularly those who have had previous miscarriages or stillbirths and is considered a routine part of the antenatal examination within an Australian and New Zealand maternity context (Grigg, 2015, p.591). In a New Zealand context, the New Zealand College of Midwives in its handbook for practice does not explicitly prescribe fetal heart rate (FHR) auscultation in the antenatal period, however it is implied that this is part of the antenatal assessment and plan of care at each decision point of midwifery care (New Zealand College of Midwives, 2015).

Maude (2019), outlines the procedure for fetal heart auscultation in the chapter on fetal heart monitoring in popular Australian and New Zealand version of Skills for Midwifery Practice:

Discuss the procedure with the woman and gain her informed consent. Encourage the woman to empty her bladder. Undertake an abdominal palpation...; Lubricate the Doppler ultrasound probe with a suitable conductive gel to facilitate ultrasound transmission; position the Doppler probe over the area where heart sounds are expected...; count the heart beat for 1 minute...; simultaneously palpate the maternal radial pulse to ensure it is the fetal heart that is being heard; reassure the woman about the other sounds that can be heard; wipe off gel with a tissue; discuss the results with the woman; document the time of listening, the device used, the fetal heart rate (as a single number), any other information obtained during monitoring, and a plan for follow-up (if required) (Maude, 2019, in de-Vitry Smith & Bayes, p.319)

As this thesis focuses on the experiences women have of using handheld Doppler monitors and other devices to auscultate the fetal heart rate outside of a clinical setting, YouTube was searched for peer-to-peer ‘how-to’ tutorials. YouTube ([www.youtube.com](http://www.youtube.com)) was searched on 12<sup>th</sup> August 2019 using the search term ‘how to use fetal Doppler’. A total of sixty-six hits were generated, and the results refined to include only content that instructed viewers how to use a handheld fetal Doppler; a total of thirty-eight hits. The videos had viewer counts between 166 and 8.6 million,



with many videos created by ‘vloggers’ who regularly post video updates about their lives, particularly focusing on fertility, pregnancy, and parenthood. The videos varied in length from twenty seconds to one hour and forty-two minutes and had been uploaded to the website between 2010 and 2019. Results were excluded if it was not intended to show viewers how to use a handheld Doppler, such as vlogs sharing the sound or display from the Doppler with no explanation on how to use (Figures 2 & 3).



*Figure 2: A type of handheld Doppler marketed to women.*

*This type was commonly seen used in YouTube videos reviewed in this study. It is designed to show the fetal heart rate as a numerical value on the display panel.*

*Source: L.A. Honeyman*



*Figure 3: Another type of handheld fetal Doppler marketed to women. This type does not have a built-in display or speaker, and requires the user to attach headphones to hear sound. Audio can be recorded by this device and can be uploaded to the user’s computer via a USB cable.*

*Source: L.A. Honeyman*

Included results were then examined for qualitative content and accuracy to clinical procedural guidance for use as outlined by Maude (2019, p.319). The majority of the YouTube videos correctly described the sounds that could be heard when auscultating the fetal heart; including sounds of movements, the sound of the fetal heart, the sound of the maternal heartbeat, and the sound of the placenta. Whilst most videos correctly identified landmarks, such as the pubic bone in early pregnancy, in order to correctly place the Doppler probe; only one video suggested checking maternal radial pulse prior to commencing in order to differentiate it from the fetal heart. While twenty-seven of the videos correctly identified sources of sounds heard on the handheld Doppler, six incorrectly identified the sound of the fetal heart or did not correctly describe where the fetal heart could be located. Two had incorrectly referred to the pubic bone as the 'vagina bone', one of whom identifying on her YouTube channel that she was a registered nurse. Majority of the videos used a handheld fetal Doppler monitor, except for one which attempted to use a smartphone app that uses the smartphone microphone to pick up the fetal heart rate, record, and be able to play back recordings – none of the recordings shown in the video appear to have recorded a correct fetal heart rate. Seventeen vloggers reported that they believed that the display on their device was incorrect and did not show an accurate number of beats per minute. Fifteen of the vloggers reported that they had chosen to buy or hire a handheld fetal heart rate monitor in order to alleviate anxiety, and have peace of mind that their pregnancy was progressing well in between visits to their care provider or ultrasound scans, citing previous issues with fertility or miscarriage as a reason for doing so. Four reported that they had sourced theirs for connecting with their unborn baby, including as a way for the father to be involved in the pregnancy journey. Only one explicitly stated that they had purchased a handheld fetal heart rate monitor for fun. These results are reproduced in Table 1.

**Table 1: YouTube video content analysis.**

Content Analysis	n= 38
YouTube channel is a company selling handheld fetal Doppler	6
YouTube channel received Doppler from a company specifically for review	3
Using iPhone app that uses inbuilt microphone as a Doppler	1
Peace of mind, reduction of anxiety	15
Purchased for fun	1
Connecting with the unborn baby	4
Identifies correct landmarks (pubic bone, umbilicus)	17
Checks maternal pulse to differentiate it from FHR	1
Correctly identifies sounds and possible sources	27
Incorrectly identifies landmarks or sounds	6
States not a replacement for medical care or diagnosis	7
States concerns around safety of ultrasound use	1
States display of handheld fetal Doppler is not accurate	17

## 1.2 The Problem

With technology evolving and becoming ever more available and affordable, medical-grade and purpose made devices used for listening to the fetal heart rate of an unborn baby has become accessible to non-health professionals either via online marketplaces or smart phone applications, or 'Apps'. There are many unknowns around how this technology is being used by pregnant women, but it is assumed by established advice by midwifery, obstetric, and stillbirth awareness groups to be at the expense of fetal movement monitoring by the pregnant woman. This potentially delays her contacting her lead maternity carer (LMC) urgently should there be a reduction or absence of movements which is the strongest indicator of fetal wellbeing and possibility of stillbirth (International Stillbirth Alliance, 2017, p.3).

In 2009, one case study discussed in both the British Medical Journal (BMJ) and the British Journal of Midwifery (BJM) highlighted an incidence of home fetal Doppler monitor use where an intrauterine fetal death (IUFD), with no known cause, had subsequently occurred (Chakladar & Adams, 2009; Daniel, 2009). Chakladar and Adams suggest that while the IUFD may have been

unavoidable in this case, consumers relying on these devices could delay seeking medical attention due to false reassurance and suggest that maternity providers “need to educate expectant mothers about the limitations and the potentially fatal consequences of untrained use of fetal heart monitors” (2009, p.2). Daniel adds that this case highlights the dangers “of relying on medical devices and/or information instead of consulting their doctors and midwives directly” and warns against potential abuse of fetal heart rate monitoring technology by untrained users (2009, p.813). Neither identify a need for further research into the use of these devices by women, despite them being commercially available to the general public for purchase.

The charitable organisation Kicks Count, based in the United Kingdom (UK), also warn against consumer use of home fetal Dopplers and had in 2017 launched a petition on website change.org to draw the UK Government’s awareness to the issue (<https://www.change.org/p/theresa-may-mp-ban-the-over-the-counter-sale-of-home-dopplers-8c948a58-5fc5-4abb-a320-5b689006ad30>). In October 2017, UK Member of Parliament (MP) Antoinette Sandbach introduced a private member’s bill known as the *Fetal Dopplers (Regulation) Bill 2017-19*, with the aim that the bill would help to reduce the number of stillbirth and neonatal deaths through restricting sale of handheld Dopplers to consumers and placing the responsibility of device use “in the hands of medical professionals, and encourage mothers to respond to changes in the movements of their babies rather than using devices that can be bought over the counter for £30” (Hansard, 11 October 2017, col 345). However, this bill does not resonate with the findings of one small qualitative study where women who chose to use handheld Dopplers did so within the “first two trimesters of pregnancy to allay anxiety after previous miscarriage or threatened miscarriage, to simply establish the continued life of their foetus” (Middlemiss, 2018, p.1). This is prior to the time period where fetal movement is perceived by the woman, as early as 15- to 16-weeks’ gestation for multiparous women, and between 18- and 21-weeks’ gestation for primiparous women (Grigg, 2015, p.592). It could be argued that women who choose to use handheld Dopplers in this context are primarily enacting personal agency by managing their anxiety and perceptions of lack of control, along with the sense of responsibility that pregnancy brings and not, as suggested by the authors of the BMJ and BJM case studies in 2009, as a fun device for bonding and play (Middlemiss, 2020, p.165; Chakladar & Adams, 2009; Daniel, 2009, p.813). As at February 2020, the *Fetal Dopplers (Regulation) Bill* has failed to pass through the UK Parliament (UK Parliament, n.d). No similar action has been undertaken in New Zealand to date. Despite these concerns, women still choose to use their own devices at home. The reasons for this use are little understood, despite one UK-based qualitative

study exploring women's views, and there is no published New Zealand-based research to draw from. This project aims to develop an understanding of the use of personal fetal heart rate monitors by pregnant women, in order to better support midwives and pregnant women in appropriate use of such technologies.

### 1.3 Positioning Myself

As a digital native millennial<sup>1</sup>, the idea of technology and its use in a home-based context is not an unusual or novel concept to myself or others of my generation. However, at times this comfort with technology feels at odds with a holistic midwifery philosophy, where there can be tension around technology use during pregnancy and childbirth. Anthropologist Robbie Davis-Floyd describes these divergent paradigms of childbearing as being technocratic, holistic, or humanistic within industrialised, Western, contexts. Technocrats see childbearing as inherently risky, the body as a machine that can falter, made safer by the presence of technology and systematic requirements that pregnant women must accept and follow (Davis-Floyd, 2001). Holistics view the body as energy, a force that is inherent and individual, with each individual needing to take their own responsibility to be open to 'healing' and each practitioner needing to take individualised approaches to help achieve that aim (Davis-Floyd, 2001). Humanists sit between the technocrats and the holistics, viewing the body as an organism rather than a machine or as energy, aiming for shared responsibility between practitioner and pregnant woman, and being open to a balance of technology and holism reflexive to the needs of the woman (David-Floyd, 2001). Aiming for the middle ground of a humanistic approach to me feels a natural stance for myself as a midwife of the twenty-first century, and as someone currently in my childbearing years having grown up with the various advancements in technologies. This leads me to my professional interest that provided the basis for this thesis.

My professional interest in how women use these technologies that had been originally developed for health care professionals assumed to be trained in their use began with being asked by pregnant women within an antenatal clinic context:

- a) About handheld fetal Dopplers, and if I could recommend a brand that they could buy to use at home;

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<sup>1</sup> Being born in the late 1980s, I am part of the generation brought up amongst advances in technology such as home computers, mobile phones, and internet accessibility. My father being an early adopter and holding an interest in computers meant that I have lived with the technology since birth and have grown up alongside it. By my early teens I already owned a mobile phone – a Nokia 3310. By my late teens, the now ubiquitous smartphones had made their appearance.

- b) Comments on the wide range of cost between devices aimed at pregnant women and those aimed at health professionals.

Whilst I could not comment on why there was such a great cost disparity between devices meant for marketing to non-health professionals and those meant for clinical use, the only advice I felt I could give confidently was based on professional lines rather than anything research-based; that these devices are not recommended, from which followed education about signs of fetal wellbeing, such as fetal movement awareness education. On postnatal home visits around that same time period of being asked about the devices in clinic, I would occasionally spot a handheld fetal Doppler carefully boxed up and placed on a bedside table or bookshelf, no longer needed as the baby had since been born. I had wondered what the woman would do with the handheld fetal Doppler next, if it would be kept for the next time or given to another pregnant woman.

Around the same time, my own personal social networking accounts were starting to bombard me with sponsored advertising focusing on fertility, pregnancy, and parenthood. Obviously, my demographic as a female of childbearing age meant that I was in want of these services and products. The most interesting of these advertisements were handheld fetal Dopplers, particularly one app-based system that had an attachment one could purchase to turn a smart phone into a Doppler with the ability to record and share recordings of the fetal heart. This website, as of July 2020, has shut down and states the product is no longer available<sup>2</sup>. However, using the search engine Google for fetal Dopplers presents sponsored marketing for many types of handheld fetal Dopplers aimed at pregnant women at the top of the list of search hits.

#### 1.4 NZ Maternity and Midwifery Context

The setting that this research takes place in is within the lower North Island of New Zealand, of which the Greater Wellington Region is part of. The New Zealand maternity system is often referred to as unique in comparison to those of other countries due to the integration of autonomous midwives as the primary care provider, and the role of partnership between professional and consumer as a model of care, and underpinning professional and regulatory policy and decision-making (McAra-Couper, et al., 2014; Guilliland & Pairman, 2019). Midwifery autonomy was restored in New Zealand under the 1990 Nurses Amendment Act thanks in part to work done by midwifery professionals and maternity consumers socially and politically through the 1980s, and this is still reflected nearly three decades later with consumer members having

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<sup>2</sup> <http://www.unbornheart.com/>

integral roles within the Midwifery Council of New Zealand, Maternity Standards Review (MSR) committees and as reviewers of midwifery practice, and as members of the New Zealand College of Midwives (NZCOM), in addition to partnership with women being a key tenet of midwifery practice in New Zealand (Pairman, 1999; Midwifery Council of New Zealand, n.d.; New Zealand College of Midwives, n.d.). The midwifery partnership model as described by Guilliland and Pairman carries the principles of equity, reciprocity, shared decision-making and responsibility, and informed choice; with all midwives in New Zealand tasked to uphold this model regardless if they are a lead maternity care (LMC) midwife, or a core (employed) midwife (2019).

Equity, as described by the World Health Organisation (WHO) is “the absence of avoidable or remediable differences among groups of people, whether those groups are defined socially, economically, demographically, or geographically” (2020). The New Zealand Ministry of Health (2019) has further defined equity in the New Zealand health care context to state:

In Aotearoa New Zealand, people have differences in health that are not only avoidable but unfair and unjust. Equity recognises different people with different levels of advantage require different approaches and resources to get equitable health outcomes.

In addition to the Ministry of Health’s work on equity in the whole health system within New Zealand, equity under the midwifery partnership model reflects that the woman and the midwife have a dynamic relationship, and bring their own different areas of expertise to their partnership; as without the knowledge of self and context the woman brings, the midwife cannot fully employ their professional knowledge and skill in a way that would benefit the woman, her baby, and her family through the childbearing period (Guilliland & Pairman, 2019). This also reflects Te Tiriti o Waitangi/The Treaty of Waitangi<sup>3</sup>, in that the midwife does not have sovereignty over the pregnant woman but uses her power to bring forward and enhance the woman’s innate power (Benn, 1999).

Reciprocity within the midwife-woman partnership describes an empowering and mutually beneficial relationship underpinned by the two-way sharing or mutual exchange of information (Pairman & McAra-Couper, 2015). For the midwife, reciprocity with pregnant women has been

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<sup>3</sup> Te Tiriti o Waitangi/The Treaty of Waitangi is the founding document of New Zealand, an agreement made between a number of Māori rangatira (chiefs) and the British Crown on 6<sup>th</sup> February 1840. The treaty was written in both Te Reo Māori and in English, and in principle, it is a statement of reciprocity – where sovereignty was exchanged for a guarantee of continuation of the authority of rangatira, land, resource rights, and access to the same rights and privileges as a British citizen. However, debate still continues around specific translations and transliterations between the versions and the impacts they have had over tangata whenua (the people of the land) to the present day.

noted to sustain their passion and satisfaction in midwifery, particularly in case loading models of care (McAra-Couper, et al, 2014). Shared decision-making requires the midwife to provide up-to-date and evidence-based information in an accessible way to the woman, and the woman to provide information about herself and family (Guilliland & Pairman, 2019).

In the New Zealand health care context, the right to be informed, and to have informed choice and informed consent is enshrined in the Code of Health and Disability Services Consumers' Rights<sup>4</sup> within the Health and Disability Commissioner Act 1994 (Health and Disability Commission, 2020). This right ensures that health care consumers are presumed competent to make informed choices and give informed consent, that all information about their condition and options are provided to them, that they have the right to be treated by their choice of care provider where practicable, and that they can withdraw consent for treatment and refuse services (Health and Disability Commission, 2020).

Historically, the imperative of informed choice developed from legal and bioethical developments during the 20<sup>th</sup> century, particularly following the Nuremburg Trials of Nazi doctors in 1947 (Anderson & Thorogood, 2015). Within New Zealand, The Cartwright Enquiry of 1988<sup>5</sup> was also fundamental in development of local legal frameworks underpinning the right to informed choice which then informed the Code of Rights as described previously (Anderson & Thorogood, 2015). For midwives practicing in New Zealand, informed choice is a right that needs to be upheld as a responsibility to the pregnant woman and is inherent to the principles of the midwifery partnership model (New Zealand College of Midwives, 2015).

The elements of the maternity system may have some influence on how pregnant women within New Zealand decide whether or not to use a handheld fetal Doppler, particularly due to the impetus for partnership between woman and midwife.

### 1.5 Research Question and Aims

Given that little is known about how pregnant women use handheld fetal Dopplers, the research question aims to address this knowledge gap. What factors are driving pregnant women to purchase or borrow, and use a fetal heart rate monitoring device? Specifically; why they are

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<sup>4</sup> Health and Disability Commissioner (Code of Health and Disability Services Consumers' Rights) Regulations 1996.

<sup>5</sup> In 1987 it was alleged in an article published in *Metro* magazine that women receiving care at National Women's Hospital in Auckland for cervical cancer were unknowingly enrolled in an unapproved study which led to inadequate treatment of their condition, resulting in death. The Cartwright Enquiry subsequently found this was a part of a pattern of concern around the treatment and research of cervical cancer at the hospital as far back as 1966 and a breach of the right to informed choice.



choosing to use a handheld fetal Doppler, how they are using the device, and what information and supports underpin their decision-making.

#### 1.6 Structure of Thesis

This thesis is set over five chapters, this chapter being the overview of the issue of use of handheld fetal Dopplers by pregnant women for context of the thesis. The second chapter reviews literature related to concepts around technology use by pregnant women, and existing forms of telemedicine already in accepted practice, as well as what is considered best practice for monitoring fetal wellbeing during the antenatal period. The methodology and rationale for the study design used as part of this thesis is presented in the third chapter. Chapter four presents the thematic analysis of the findings from the interview data. The findings are discussed in the fifth chapter, and consideration of the strengths and limitations presented, with future lines of enquiry proposed.

## Chapter 2: Literature Review

### 2.1 Introduction

In the previous chapter, the research question was introduced: What factors are driving pregnant women to purchase or borrow, and use a fetal heart rate monitoring device? Specifically; why they are choosing to use a handheld fetal Doppler, how they are using the device, and what information and supports underpin their decision-making.

This chapter focuses on the literature reviewed throughout this thesis. As there is little direct research focused on women's use of handheld fetal Dopplers at home, the literature reviewed focused on similar aspects: women's experiences of ultrasounds and other monitoring technology in a clinical context, including home blood pressure monitoring. The use of digital media, such as smartphone applications, and women's experiences of using this form of technology in their pregnancy, was also reviewed. This chapter has seven sections: the introduction, search strategy; handheld fetal Doppler use by pregnant women; monitoring of fetal wellbeing; digital media, apps, and devices; home blood pressure monitoring; and the summary. Section 2.4 is split into three subsections: ultrasound, cardiotocography, and fetal movement awareness. Section 2.6 is split into two subsections: device validation, and self-monitoring.

### 2.2 Search strategy

Te Waharoa, the search engine of the library/Te Pātaka Kōrero at the Victoria University of Wellington, and Google Scholar were utilized to search the literature. Databases searched included EBSCO, CINAHL, and Cochrane Database of Systematic Reviews. Initial searches conducted during the conception of this study, specifically around handheld fetal Dopplers, did not show any specific research for women's experiences, and only addressed clinical research for Intermittent Auscultation and Continuous Electronic Fetal Monitoring in the intrapartum period. Searches for related and similar technologies focused on 'fetal monitoring, antenatal'; 'fetal movements'; 'mobile apps'; 'non-stress test, fetal'; 'self-diagnosis'; and 'telemedicine'; and 'ultrasound, antenatal'. Literature searches commenced in February 2018 and repeated in three-monthly intervals until June 2020. All results were written in English, peer-reviewed, and published since 1999. Midwifery-specific journals were also searched to find related articles that were not identified via the keywords.

### 2.3 Handheld Fetal Doppler use by pregnant women

Specific literature around the topic of pregnant women using a handheld fetal Doppler or similar device outside of a supervised medical context is sparse. The only published research as of March 2020 was by sociologist Aimee Middlemiss, who interviewed fifteen women in the United Kingdom who had previously suffered a miscarriage or stillbirth and had chosen to use a handheld fetal Doppler in a subsequent pregnancy. The women mainly used handheld fetal Dopplers to control anxiety around the risk of an adverse outcome of pregnancy, that is, miscarriage or stillbirth, through acquiring knowledge about the state of their unborn baby (Middlemiss, 2020, p.162). This considered response to the issue of anxiety around a 'precarious pregnancy' was acceptable to the women, as it put them in control of managing their anxiety about the continued life of their unborn baby rather than needing to wait for access via their midwife or obstetric team (Middlemiss, 2020, p.165-166). The women involved in the Middlemiss study felt that despite the risk of being unable to find a fetal heartbeat, access to real-time information about their unborn baby before being able to feel fetal movements were essential for their wellbeing (2020, p.171-172). Once fetal movements, the quickening, occurred the women felt able to reduce their use of the handheld fetal Doppler as they felt they were beyond the threat of a miscarriage and the information they sought about the ongoing life of their unborn baby was now from fetal movements (Middlemiss, 2020, p.171). Also, the women felt that they did not want to be perceived by their midwife or obstetrician as demanding and that being able to alleviate their anxiety on their terms was something they could do personally and had responsibility for (Middlemiss, 2020, p.171). The women were able to purchase a handheld fetal Doppler online easily. They could seek information on using it via peer-to-peer resources such as YouTube and from observing their midwife during antenatal appointments (Middlemiss, 2020, p.170). This research is a small-scale qualitative study set in the United Kingdom and is the only published research on pregnant women using handheld fetal Dopplers in pregnancy. While both the UK and New Zealand offer midwife-led care as the primary mode of maternity care, the NZ system is unique because the pregnant woman can choose her care provider, with continuity of care being the standard.

The use of handheld fetal Dopplers as part of a telehealth model of maternity care for low-risk pregnant women has been explored by one clinic in the USA as a way to reduce the number of antenatal clinic visits in a manner acceptable to women and to reduce the burden of over medicalisation and cost to the system and user (Meylor de Mooij, et al., 2018). As part of the OB

Nest study, six women were given a handheld fetal Doppler, and a blood pressure monitor, and taught how to use these devices as well as self-perform fundal height measurements and maternal weight (Meylor de Mooij, et al., 2018, p.460). Interestingly, the authors suggested that the women were able to use the handheld Doppler “to assess fetal heart rate at their leisure, providing reassurance during periods of minimal fetal movement” (Meylor de Mooij, et al, 2018, p.460). It is not elaborated if this meant that this was due to maternal perception of decreased fetal movement, or if this was during the first and second trimesters when fetal movements are not yet perceived by the woman or are sporadic following the quickening. Fetal movement awareness and its significance in antenatal care are discussed in section 2.4.3. For the women who experienced the telehealth model of care, they rated having the “tools and knowledge to be experts on their own pregnancy” as an empowering experience, and self-monitoring their unborn baby’s fetal heart rate as not only reassuring and joyous, but as meaningful to them (Meylor de Mooij, et al, 2018, p.462). While this study focuses on a small number of women in an obstetric-led maternity care system, the aim for women to feel empowered and to be experts of their own experience is part of the midwifery partnership model of care within New Zealand. In both the OB Nest study and the Middlemiss study, women found meaning in hearing their unborn baby’s heartbeat in their home environment. They found it a reassurance, mainly when there were concerns around miscarriage.

## 2.4 Monitoring of Fetal Wellbeing

Within a New Zealand context, fetal monitoring takes various forms utilising both technological and non-technological means. The use of ultrasound imaging, handheld Dopplers or Pinard fetoscopes, cardiotocographs, and awareness of fetal movements are all employed throughout the antenatal and intrapartum periods to determine fetal wellbeing and monitor for potential complications to reduce the number of stillbirths. The use of ultrasound, cardiotocography, and fetal movement awareness in the antenatal period are discussed below.

### 2.4.1 Ultrasound

The use of ultrasound in the antenatal period to ascertain an estimated due date and the plurality of fetuses, screen for fetal abnormalities, assess estimated fetal weight and placental function, and monitor fetal wellbeing in high-risk pregnancies is a well-established and accepted practice within maternity care in New Zealand.

Modern ultrasound generates a real-time image in two-dimension (2D) from piezoelectric crystals generating energy to produce ultra-high frequency sound, which is then directed into the body via

a probe, and an image generated from the time it takes for the sound to return to the probe, measuring tissue depth and density in a cross-section (Crabtree Burton & Luciani, 2012, p.46). Three-dimension (3D) ultrasound adds the ability to create and view images on multiple planes, not just a cross-section as 2D ultrasound images show, and four-dimension (4D) ultrasound enhances 3D ultrasound images by being able to look at multiple planes over time, such as fetal facial expressions (Crabtree Burton & Luciani, 2012, p.50-52). Ultrasound technology was first developed during World War Two (1939-1945) to detect submarines. It works by utilising the Doppler Effect, where sound pitch changes in response to the source of the sound moving, as hypothesised by Austrian mathematician Christian Doppler in the 1840s (Uppal & Mogra, 2010). Ultrasound's potential application in health care was first explored by surgeon Ian Donald in 1955 – first for imaging of abdominal tumours, and then to view human development in utero (Tracy & Cowan, 2015, p.529). By the 1970s, ultrasound imaging became standard practice within maternity care, prompting not only a revolution in antenatal care but also a cultural shift in how pregnant women view pregnancy, their families, and by society – with ultrasound seen as a way to bond with the unborn baby and give them an identity before their birth (Taylor, 2008, p.4). This cultural shift of view regarding the role of ultrasonography in pregnancy has created a commodification of the unborn baby, with photographic and videographic mementos made available to the pregnant woman to share with her friends and family, as well as used for commercial marketing of products and advertising of socio-political standpoints (Taylor, 2008, p.28-29).

Studies in the effects of ultrasound on the developing fetus have been ongoing since the late 1980s, particularly investigating safety for use during pregnancy. Currently, there are no known clear long-term consequences of ultrasound exposure to fetal growth and development demonstrated by longitudinal studies from the late-1980s to the mid-1990s (Alfirevic, et al., 2015; Bricker, et al., 2015; Whitworth, et al., 2015). However, a few of the studies demonstrated some unexpected findings that require further investigation. In one study performed in Perth, Australia, in 1993 comparing neonatal outcomes of fetus' undergoing intensive serial ultrasound and Doppler monitoring compared to non-serial non-Doppler ultrasounds, an unexpected finding of a higher chance of intrauterine growth restriction (IUGR) amongst those intensively monitored was considered by the authors not to be a chance effect, and that the exposure of these fetuses' to frequent ultrasound may have been an influential factor (Alfirevic, et al., 2015, p.16). In a study performed in Norway in 1993, it was demonstrated that a higher number of children who had

been exposed to ultrasound in utero were left-handed; however, this same finding was not noted in studies commenced in Sweden in 1988, and the data collected relied on a limited number of questions to the parents and caregivers of the children from the Norwegian study (Whitworth, et al., 2015, p.18). Longitudinal studies have not observed a link between exposure to ultrasound and Autism Spectrum Disorder (ASD) diagnosis in childhood (Bricker, et al., 2015, p.18). While ultrasound is considered safe, there is still a theoretical risk as ultrasonic energy that propagates through tissue is converted to heat and side effects have been noted within laboratory settings using continuous wave ultrasound focusing for long periods on one location using high power output (Bricker, et al., 2015, p.7). Researchers support the principle of “As Low As Reasonably Attainable” (ALARA), with operators advised to keep examinations as brief as possible and minimise dwell time over target areas for examination (Bricker, et al., 2015, p.7). It is this principle that guides groups, such as the United States Food and Drug Administration (FDA), to advise against the purchasing of handheld Doppler monitors for use at home and the practice of ‘keepsake’ ultrasounds – ultrasounds performed for non-clinical indications by commercial entities or medical practitioners for the sole purpose of expecting parents being able to see their unborn baby – as there is questionable training on how to use the devices (Food and Drug Administration, 2014).

#### *2.4.1.1 Women’s Experiences of Ultrasonography in Pregnancy*

Ultrasonography in pregnancy has become an accepted and expected element of antenatal care in many countries, including New Zealand. Women’s experiences of ultrasounds during their pregnancies have been investigated since the late 1970s when the technology and its use was still in its infancy. In a systematic review conducted in the early 2000s, 74 studies ranging from the late-1970s to the 1990s, focusing on women’s views of ultrasound were identified (Garcia, et al., 2002). Overall, women in the 74 included studies in this systematic review reacted highly positively to ultrasound in their pregnancy, and particularly appreciated the opportunity to see their unborn baby and felt greatly reassured that their unborn baby was developing without issue (Garcia, et al, 2002, p. 229). Studies from earlier in the period reviewed suggested that women unfamiliar with the technology were concerned that it would harm them or their unborn baby and that the procedure would be invasive; however, the later studies seemed not to suggest this was an issue for women (Garcia, et al, 2002, p.229). Despite being a way to reassure, women who had a false-positive finding, such as the unborn baby having a structural abnormality that was later not found to be so, continued to be anxious following subsequent reassuring scans (Garcia, et al, 2002,

p.231). Those who had to return for a follow-up scan due to the sonographer being unable to view all elements of a morphology scan also expressed feelings of extreme anxiety that there was something wrong with their unborn baby (Garcia, et al, 2002, p.231). Also, women who had reassuring ultrasound scans during pregnancy but then birthed a baby who had unexpected anomalies believed that such issues should have been picked up on ultrasound; however, this could highlight that the women in this study were not fully informed about the strengths and limitations of antenatal ultrasonography (Garcia, et al, 2002, p.231). The unexpected diagnosis of a miscarriage provided a paradoxical finding of women both feeling the images exacerbating and prolonging their grief and helping the grief process by providing proof that their unborn baby existed and reality that the loss had occurred (Garcia, et al, 2002, p.232). While the technology in these studies have long since evolved, as have the indications for ultrasound use in pregnancy, the views of the women in these studies do not seem to have changed overly much when compared to more recent studies.

A qualitative study of 8 pregnant women from Norway focused on women's experiences of ultrasound during pregnancy also showed that women consider ultrasound to be a positive and reassuring element of their antenatal care, and mainly focused on how it helped them feel pregnant, could bond with their unborn baby, and could involve their partner in the process (Øyen & Aune, 2016, p.10). The Norwegian maternity system at the time of publication of this study suggested only one routine ultrasound scan at 18 weeks gestation. Women in this study did desire to have more scans despite uncertainty around if there were any safety concerns around having a greater number of ultrasound scans during pregnancy (Øyen & Aune, 2016, p.11). Women also expressed social pressure to have an ultrasound, particularly from family and friends, and felt an expectation and responsibility to accept ultrasound scanning as part of their antenatal care (Øyen & Aune, 2016, p.11). There was a disconnect between the view of women and their perceived view of maternity carers, with women placing emphasis and value on visualising their unborn baby as a means of bonding, and believing maternity carers place value on screening for abnormalities of the unborn baby, with women wanting greater recognition of the emotional factors of the ultrasound from their carers (Øyen & Aune, 2016, p.11). Overall, women in this study viewed ultrasound scanning in pregnancy as preparation for parenthood and an essential element of their care to ensure a healthy and successful pregnancy (Øyen & Aune, 2016, p.11).

In a qualitative study of 15 women undertaken in The Netherlands undergoing serial scanning for a small for gestational age (SGA) fetus, women viewed the ultrasounds as a necessity for monitoring

their unborn baby and felt comfortable and safe despite the uncertainties of an SGA diagnosis and the disruption and anxiety that the lead up to the scans caused (Vollgraff Heidweiller-Schreirs, et al., 2019, p.10). The women mainly described ultrasounds as a special time that they and their partner could see their unborn baby, with some wishing they could have daily ultrasounds but understanding that this could be an unrealistic endeavour due to logistics and clinical appropriateness for tracking the growth of their unborn baby (Vollgraff Heidweiller-Schreirs, et al., 2019, p.5). Ultrasonography in pregnancy is both expected and acceptable to pregnant women, with the value of seeing their unborn baby rating highly amongst the experiences described in qualitative research since the late 1970s.

#### 2.4.2 Cardiotocography

Continuous or intermittent electronic fetal monitoring using cardiotocography (CTG) is a technology with simultaneous use of an ultrasound transducer (to measure fetal heart rate) and tocometry (to measure frequency and duration of contractions) with both measurements a printed onto paper output continuously (Maude, et al., 2014). The technology was developed by Dr. Koran Hammacher in collaboration with information technology company Hewlett Packard (HP) in the 1960s and primarily aimed to eliminate the condition of cerebral palsy (CP) via intervention before hypoxic insult to the fetus during labour (Pateman, et al., 2008, p.454).

However, CTGs lack the sensitivity and specificity required to diagnose CP, and it is now thought that up to 90% of CP occurs before labour commences, usually as a result of events such as infection or haemorrhage during pregnancy (Pateman, et al., 2008, p.454). When used as a method to reduce perinatal mortality, the introduction and use of CTGs have shown no statistically significant reduction in fetal or neonatal death (Grytten, et al., 2018, p.4450). There are many possibilities why CTGs have failed to reduce overall perinatal mortality. One such issue is the practice of visual interpretation of a CTG trace, which can have a high degree of inter-observer and intra-observer variability and inconsistencies, depending on the observer's experience and training of the observer (Krupa, et al., 2011, p.2). Additional issues include low reproducibility and high false-positive rates (Grivell, et al., 2015, p.14). Artificial intelligence has been proposed with the aim of more accurately interpreting CTG traces; however, the uptake of this has not been wide spread (Krupa, et al., 2011, p.3). A further systematic review of six studies of artificial intelligence, specifically S-T Waveform Analysis (STAN), concluded that there was insufficient evidence to suggest its use to reduce the burden of fetal metabolic acidosis (Blix, et al., 2016). While the CTG was primarily developed for the intrapartum period, it is also used during pregnancy as a non-



stress test (NST) to screen for concerns around fetal oxygenation from placental insufficiency, mainly where there are risk factors such as decreased fetal movements or a small for gestational age fetus (Nazari, et al., 2018, p.1384). However, a review of studies in 2015 did not show good evidence supporting the use of standard or artificially intelligent CTG antenatally (Grivell, et al., 2015, p.14). There is a lack of evidence regarding women's views of CTG monitoring during the antenatal period (Grivell, et al., 2015, p.8).

Within low-resource settings, a novel device, known as Moyo, has been developed to bridge the gap between intermittent auscultation (IA) – which relies on one-to-one midwifery staffing within an intrapartum care setting – and CTG – which relies on expensive equipment, access to reliable sources of electricity, training in how to interpret recordings, and resources to appropriately act on the clinical picture promptly. The Moyo is a wearable Doppler device with a rechargeable battery and monitor which can simultaneously monitor fetal and maternal heart rates, which can aid detection of non-reassuring fetal heart rate patterns as trends can be observed over thirty-minute periods on an electronic display with software that alerts the users to values outside of acceptable parameters (Kamala, et al., 2019, p.3). Compared to a handheld Doppler with two piezoelectric crystals, the Moyo has nine, which increases the area in which the device can detect a fetal heart rate. One qualitative study explored the experiences of multiparous women in low-income settings with this device utilised in their most recent labour experience. Women in this study reported feeling that the Moyo device was acceptable to them, eased their fears about fetal wellbeing during labour, and aided their ability to actively engage in clinical aspects of their labour care (Rivenes Lafontan, et al, 2018, p. 6-7). However, some participants in this study were unaware of the purpose and function of the Moyo device, with some stating that they were unable to take in the information due to their advanced labour, and some were overestimating the diagnostic ability of the device to include being able to detect fetal abnormalities, being able to make the fetus breathe, or speeding up the progress of the second stage of labour (Rivenes Lafontan, et al, 2018, p.4-5). The qualitative study findings are similar to other forms of monitoring during pregnancy, in that women feel actively engaged in their care and gain reassuring feedback about the wellbeing of their unborn baby.

#### 2.4.3 Fetal Movement Awareness

Maternal awareness of fetal movements has become in itself a screening tool for fetal wellbeing, with a reduction in movement heralding a risk for stillbirth and other adverse fetal and neonatal outcomes. However there remain inconsistencies in approaches to how best to measure maternal

perception of fetal activity and how to optimally manage decreased fetal movements (Bradford, et al., 2019, p.1; Warland & Glover, 2017, p.23). Along with these inconsistencies in approaches of measurement also lie continued misconceptions around what stimulates fetal movement, the language used to describe fetal activity, and what factors of fetal movements and activity are reassuring (Warland & Glover, 2017; Bradford, et al., 2019; Bradford & Maude, 2018).

Fetal movements have clinical significance, with the presence of movements indicating that the unborn baby is growing and developing normally. A perceived reduction or an absence of movement indicating an increased risk of stillbirth and other adverse outcomes such as congenital anomalies and long-term neurodevelopment impairment (Bradford, et al, 2019). Fetal movements are first perceived by a pregnant woman in the second trimester, approximately between 16 and 21 weeks, initially as subtle and irregular movements described as flutters or bubbles that could be mistaken for other bodily sensations (Grigg, 2015; Bradford & Maude, 2018). This moment of awareness is known as quickening (Grigg, 2015). By the time the pregnancy has reached 28-32 weeks gestation, the early third trimester movements feel more vigorous and are more frequent. Often movements can be seen externally or felt by a hand on the woman's abdomen (Bradford & Maude, 2018). There can be a considerable variation in types of movement at this stage, with subtle movements like wriggling, pressing, and tickling contrasting with vigorous movements like rolling, kicking, and turning – at times causing the woman to feel as if she's been thrown off balance or winded (Bradford & Maude, 2018). At term, fetal movements are more commonly perceived in the evening and through the night, and this clear diurnal pattern has appeared as a likely significant sign of fetal wellbeing – with a reduction of movements at this time of day having an increased likelihood to be a sign of compromise (Bradford, et al, 2019, p.10). Hiccups, too, are considered a sign of fetal wellbeing at term as the reflex is modulated by the brain stem and is hypothesised to play a role in the development of respiratory muscles and suckling reflex (Bradford, et al, 2019, p.7). Kick counting, or counting fetal movements over a period of time, is ineffective in reducing stillbirth due to extreme inconsistencies of what should be considered normal – anywhere between 10 movements over 12 hours, to 10 movements over 24 hours, to 10 kicks over two hours (Warland & Glover, 2017, p.25). Current best practice guidance in New Zealand suggests that women are educated about what constitutes normal fetal movements, particularly in the third trimester, and encouraged to contact their maternity carer immediately with any concerns around subjectively decreased movement (Gardener, et al., 2016, p.4). Those presenting with decreased fetal movements should be assessed within two hours of

raising their concern, initially with a cardiotocograph (CTG), and other investigations such as screening for pre-eclampsia or feto-maternal haemorrhage, and a further ultrasound considered to rule out other risk factors for decreased fetal movements (Gardener, et al., 2016, p.5).

Between four and sixteen percent of pregnant women will present to their maternity care provider with a perception of decreased fetal movement throughout their pregnancy, particularly during the third trimester (Bradford, et al, 2019; Smyth, et al., 2016). The risk of stillbirth could be increased four-fold for those women who report decreased fetal movements; however, 75% of women with a single uncomplicated episode of decreased fetal movements will go on to have a normal pregnancy outcome (International Stillbirth Alliance, 2017; Bradford & Maude, 2018). It is therefore essential that women who feel a subjective reduction or absence of fetal movement present to their caregiver promptly for assessment, as this potentially could be a critical window to avoid adverse outcomes. However, there are known barriers to women presenting promptly with decreased fetal movements. In one Australian study, midwives described non-evidence-based interventions such as kick counting or requesting the woman consume a cold or sugary drink and sit quietly over an hour or two before calling again for assessment (Warland & Glover, 2017, p.26). In a large New Zealand study, sitting quietly or side-lying may be effective in promoting fetal movements compared to standing or walking, but that consuming glucose, food, or a cold drink was less likely to do so (Bradford, et al, 2019, p. 11). Therefore, the promotion of this advice by midwives could potentially delay a prompt assessment. Additionally, where women source their information from could also promote the delay of presentation. Women in one UK study described seeking information from their immediate social networks, such as their female relatives and friends, or the internet before seeking advice from their maternity carers (Smyth, et al, 2016, p.3-4). Also, women feared not being taken seriously by their maternity carers, which in some experiences was founded by attitudes of the care providers when the woman did present for assessment (Smyth, et al, 2016, p.5). Women also feared unwanted intervention in a desire for their pregnancy to be normal, or that their maternity carer would perceive their presentation as seeking intervention, making women less likely to contact their carer regarding decreased fetal movements (Smyth, et al, 2016, p.5-6). Like in the Warland and Glover study from Australia, women in the Smyth, et al, study were also at times advised by their maternity carers to stimulate fetal movement with food, cold or sugary drinks, or by lying down or exercising (2016, p.6). Women who felt that their concerns were validated and received supportive education and advice around their presentation for decreased fetal movements felt confident to represent should they

need, while women who felt belittled and that they were wasting clinician's time were less likely to represent in the future (Smyth, et al, 2016, p.6). The presence of strong and regular fetal movements in the third trimester of pregnancy is a sign of fetal wellbeing, the reduction or absence of which needs to be promptly investigated to rule out possible fetal and neonatal morbidity and mortality.

The use of ultrasound, CTGs, and fetal movement awareness are methods of determining fetal wellbeing during pregnancy that women find acceptable as part of their pregnancy care. Positive views held by women are that the viewing of the unborn baby or the auscultation of the heartbeat can reassure them of their unborn baby's wellbeing. Negative views women may have lie in contradictory advice from caregivers, particularly around the management of reduced fetal movement, and how unexpected findings from ultrasounds are communicated.

## 2.5 Digital Media, Apps, and Devices

As of 2015, around 70 percent of New Zealanders owned a smartphone, a substantial increase from 48 percent ownership in 2013 (Research New Zealand, 2015, p.3). In addition to smartphone ownership, around three-quarters of New Zealanders have access to other devices capable of accessing the internet via laptops or netbooks (Research New Zealand, 2015, p.4). With a smartphone, software known as apps can be downloaded to personalise functions based on user needs and interests (Tripp, et al., 2014, p.64). With the rise in ownership or access to this communication technology, pregnant women are increasingly turning to online digital media for information and support (Lupton & Pedersen, 2016, p.368). In terms of apps downloaded by smartphone users, pregnancy-related apps represent a large number of available downloads; however, it is difficult to obtain a concrete number due to regional differences and differences between app stores depending on the brand of smartphone owned (Tripp, et al, 2014, p.65; Lupton & Pedersen, 2019, p.369). Women also access social media, online discussion groups, and pregnancy-related websites to gain information and support in their pregnancies (Lupton & Pedersen, 2019, p.372).

In general, women are using digital media to gain information about the growth and development of their unborn baby, along with information about pregnancy issues such as nutrition, medication, and pregnancy complications in a manner that is quick and easy to access outside of a clinical setting (Gasteiger, et al., 2019, p.23; Jacobs, et al., 2019, p.9; Lupton & Pedersen, 2016, p.371). This form of telehealth has many benefits for pregnant women and midwives, including increased health literacy, increased confidence, convenience, cost-effectiveness, minimising

geographical barriers, and accessing timely aid (Gasteiger, et al., 2019, p. 20). However, there are concerns around digital media accessed by pregnant women, particularly when it comes to app-based and social media-based formats. Foremost is the concern of evidence-based, trustworthy, and valid information. While there have been attempts at curating a list of trustworthy, valid, and evidence-based smartphone apps that focus on health and wellbeing, it has been challenging to match these to the stringent levels of clinical safety and data security under voluntary regulation codes and legislative requirements (Grundy, et al., 2016, p.1051; Soffer & Chen, 2018, p. 870). App developers and content creators do not have a mandate to ensure that medical information they present is up to date, evidence-based, or endorsed by professional or governmental health bodies (Tripp, et al, 2014, p.66).

An example of this was a review and content analysis of apps that guided pregnant women about decreased fetal movements by Daly, et al. in Australia, published in 2019. Twenty-four of the apps available for download in Australia from the GooglePlay platform met inclusion criteria. They were reviewed for content regarding fetal movements compared with contemporary clinical guidance for decreased fetal movements. All of the apps reviewed mentioned decreased fetal movements and most suggested reasons for perceptions of altered fetal activity – often presented in a week-by-week format corresponding with the current gestation of the user (Daly, et al, 2019, p.e292). Concerningly, a number of the apps incorrectly suggest to women that decreased fetal movement and activity closer to term is normal and not a cause for alarm, and do not discuss the implications of decreased fetal movements and adverse perinatal outcomes such as stillbirth (Daly, et al, 2019, p.e292-e293). Kick counting was discussed in two-thirds of the apps, but what was considered normal fetal activity varied across the apps: 10 movements over two hours, 10 movements over 12 hours, or 10 movements over one hour (Daly, et al, 2019, p.e293). As discussed in section 2.4.3, kick counting is not evidence-based or best practice advice. Advice around what women should do when they are concerned about their unborn baby's movements is also concerning. Thirty-eight percent of the apps encourage stimulating fetal movement by eating and drinking, and 25 percent advise playing loud music – neither of which are clinically shown to be effective and are actively discouraged in clinical guidance (Daly, et al, 2019, p.e294). This advice could potentially cause harm via a missed window of opportunity for a woman to present to her midwife for assessment around her concerns promptly.

Another topic of concern is apps that claim to be able to auscultate and record the fetal heartbeat using the in-built speaker and microphone of a smartphone, thus turning a smartphone into a

medical device. Professional concern around this style of app align with concerns around the availability of handheld fetal Dopplers; that they may cause harm through false reassurance or false alarm, particularly when not used by or under the supervision of a healthcare provider (Soffer & Chen, 2019, p.870). In a case report in the United States of America, a pregnant woman consented to have the heart rate of her unborn baby auscultated by her healthcare provider and then using apps found on the Apple iTunes store identified as claiming to be able to use the smartphone microphone and speaker to hear the fetal heartbeat (Soffer & Chen, 2019, p.871). Of the 22 apps included for analysis in the case study, every single app failed to detect the fetal heartbeat (Soffer & Chen, 2019, p.872). In addition to being unable to detect the fetal heartbeat, the apps also contained misinformation regarding gender heart rate differences, avoiding hot foods in pregnancy, and claims around dangers cell phone radiation that have been unproven or debunked (Soffer & Chen, 2019, p.872). False advertising aside, these types of apps could cause harm to a pregnant woman and her unborn baby through unproven and unchecked medical claims contained within the apps and false alarm by being unable to auscultate the fetal heartbeat.

However, these examples aside, apps can provide a useful adjunct to clinical care and patient education. In a study exploring women's experiences of using a smartphone app to help manage their gestational diabetes mellitus. Women from Norway were randomised to receive standard care, or standard care with the addition of a purpose-made app (Pregnant+) to track their blood sugar measurements and gain further individualised information about their condition (Skar, et al., 2018, p.103). A diagnosis of GDM left the women in this study feeling self-blame, disappointment, or sadness, particularly if they did not feel they fit the risk profile of developing the condition such as their ethnicity, age, BMI, or family history of diabetes (Skar, et al, 2018, p.104). Some experienced the app as a way to balance glycaemic control, while others experienced this as a source of stress and found the constant worry about their blood sugar levels had a negative impact, particularly if they had to make more significant modifications to their carbohydrate intake than initially recommended (Skar, et al, 2018, p.105). Also, technical difficulties with the app when either automatically transferring blood sugar values from their glucometer or manually inputting data that did not differentiate between pre- and post-meal values caused additional stress and disengagement from the use of the app (Skar, et al, 2018, p.105). Despite these negatives, women who were able to use the app successfully felt a sense of control over the management of their GDM, an excellent motivator for healthy eating and physical activity, and greater self-awareness of their health state (Skar, et al, 2018, p.105-106). However, this instant

feedback also had a downside, with some women increasing their blood sugar monitoring beyond recommendations and spending more considerable amounts of time using the app, making them feel obsessed (Skar, et al, 2018, p.106). Information on the app about diet and GDM was consistent with that received from the health professionals that the women saw for their GDM management, and women found the app beneficial as they often found information discussed with their care team challenging to remember (Skar, et al, 2018, p.106). Overall, the perception of the use of an app in this context by women was positive. However, technical issues were the leading cause of disengaging from the app, mainly when the automatic transfer of data failed (Skar, et al, 2018, p. 107). The positives of digital media, particularly apps, augment what is discussed between the woman and her midwife, and work to enhance a woman's wellbeing and confidence during her pregnancy and as a new parent. However, while the women are motivated to use digital media to seek information and to aid their decision-making, midwives do not tend to match the enthusiasm.

In a study of midwives' attitudes to information and communication technologies (ICTs) in Adelaide, Australia, midwives were reluctant to adopt digital media and communication as part of antenatal education, mainly if the source was commercial rather than government or health research-based (Dalton, et al., 2014, p.172). Midwives' perception of risk was different from a concurrent study of pregnant women in the same location, with midwives' concerns lying in potential harm to health and professional reputation if digital media advice was taken out of context by the public (Dalton, et al, 2014, p.172). However, regardless of professional concerns, women will seek opportunities to have their opinions and feelings recognised of their own volition if they perceive their needs are not met by formal antenatal care (Dalton, et al, 2014, p.172). This, too, has implications of harm if the information accessed is not balanced with current evidence and clinical practice.

Besides smartphones, technology such as smartwatches connects wirelessly to computer programs to record health data such as heart rate patterns, activity levels, and sleep tracking for users to be able to review and share (Mitroff, 2019). One such example of wearable technology marketing health-related applications is the Apple Watch, with its latest iteration being able to alert the wearer of irregular heart rate patterns and perform electrocardiograms (ECGs) and generate PDF reports to share with the user's doctor (Apple, 2020). This device has "been granted

De Novo classification<sup>6</sup> by the FDA” for use in adult populations in the United States of America (USA) (Apple, 2020).

## 2.6 Home Blood Pressure Monitoring

In recent years, medical technology has become easier and more affordable for non-health professionals to access via a pharmacy, specialty stores, or online. While this thesis focuses on the use of fetal heart rate monitoring devices and technology for use at home by non-health professionals, it is also essential to discuss scenarios where medical devices intended for use at home by non-health professionals have become more commonplace and an accepted part of medical practice. Monitoring blood pressure (BP) at home is a medical scenario that has gained acceptance by both patients and health professionals. A growing body of research underpins it within obstetrics and a well-established research basis in non-pregnant hypertensive patients (Xydopoulos, et al., 2019, p.497). As a direct comparison, this review focuses on literature for home blood pressure monitoring (HBPM) by pregnant women who have or are at high risk of hypertensive disorders during pregnancy.

### 2.6.1 Device Validation

For monitoring hypertension at home, a device for measuring blood pressure must be comparable to measurements made by a mercury sphygmomanometer, which is the measurement standard for assessing blood pressure in a clinical setting (Bello, et al., 2018, p.327). A device is considered validated for use in pregnant women if the validation study included pregnant women and analyzed data of this population separately to non-pregnant participants in at least two separate validation studies without any protocol violations (Bello, et al, 2018, p.328; Topouchian, et al., 2014, p.43). This need for separate validation compared to other populations is due to the physiological changes of pregnancy, such as increased blood volume and cardiac output, and haemodynamic changes that can vary with posture (Coad & Dunstall, 2005).

### 2.6.2 Self-monitoring

Self-monitoring of blood pressure at home is becoming a standard way of monitoring populations with hypertensive risks or as part of hypertensive management. It is becoming a preferred method of ongoing hypertensive management and diagnosis due to the ability to test blood pressure outside of a clinical setting where white coat hypertension, present in twenty-to-forty percent of

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<sup>6</sup> All novel medical devices in the USA are automatically classed as a Class III device – high risk for potential harm to the user. The De Novo classification allows the device manufacturer to present to the FDA a case that the device is a lower-risk Class I or Class II classification, or an entirely new classification. (FDA, 2019).



the population, may confound a diagnosis of hypertension, and increasing patient autonomy while reducing their time and cost burdens of increased clinic visits (Wagner, et al., 2012, p.1; Xydopoulos, et al, 2019, p.497). In a feasibility study conducted in the United Kingdom (UK), women identified as being at increased risk of pre-eclampsia in pregnancy as defined by the UK National Institute for Health and Care Excellence (NICE) guidance, were given a validated home blood pressure monitor and a protocol for self-monitoring of two blood pressure measurements morning and night, three times a week (Tucker, et al., 2017). Results from the feasibility study were favourable for patient education for self-monitoring, retention of participants, as well as achieving similar positive and negative predictive values between home and clinic-based monitoring for formal pre-eclampsia diagnosis; however, there were difficulties with adhering to self-monitoring protocols to thirty-six weeks gestation (Tucker, et al, 2017, p.7). This difficulty was explored in a qualitative study that ran post-study period with self-selected participants from the feasibility study. While women were happy to engage in monitoring and found it empowering; they did find adhering to the monitoring protocol a little challenging until they could establish a routine using electronic reminders on smartphones and by delegating household tasks to other family members in order to achieve the quiet rest periods required by the monitoring protocol (Hinton, et al., 2017, p.7). The authors acknowledge, however, that the majority of respondents were of a White British background that held higher education degrees and was from only one of the two study sites, that this makes generalising the findings difficult due to lack of diversity of those self-selecting to take part in the qualitative study, and lack of responses from participants who had pulled out from the feasibility study.

A cost-minimization study undertaken in the UK focused on the cost differential between standard care for pregnant women with hypertensive disorders within day assessment units (DAU) at local hospitals and home blood pressure monitoring with or without a purpose-built smartphone application (app) (Xydopoulos, et al, 2019). Those women eligible for the study were shown how to use a validated blood pressure monitor and urine dipsticks for monitoring proteinuria by a specialist midwife, and data was then either written by the woman into her handheld clinical notes or input into an app purpose-made for the study, with results reviewed by the specialist midwife regularly. The app also included trigger questions that screened for physical symptoms of pre-eclampsia. If responded yes to, or if the results of the blood pressure or proteinuria were above the threshold, the app would direct the woman to contact the hospital immediately. This study found that home blood pressure monitoring was clinically acceptable, with no difference in

maternal, fetal, or neonatal outcomes compared to standard care, and a cost-saving per patient requiring monitoring, especially with support from the app developed for the study (Xydopoulos, et al, 2019, pp.500-501).

The challenges of self-monitoring lie in user and clinician errors, and incorrect use of the device. One observational study undertaken in Denmark identified several challenges that patients and health professionals face when using self-monitoring: not using the device per recommendations, the health professional not being able to guarantee that the recommendations of self-monitoring are followed, the patient not being aware of the recommendations and the need to follow them, patient-induced reporting bias, health professional-induced data-transfer bias, and risk of recording the wrong user data (Wagner, et al., 2012, p.5). Patient education must be comprehensive, clear, and understandable; there should be adequate time and resource to ensure adherence to protocols and recommendations; that the patient documents results clearly if manually recording results; that only the intended patient should use the device assigned to them in the case of the device storing or transmitting data recorded; and clinicians must take care when entering manually recorded data to reduce transcription error.

New Zealand guidance on diagnosis and treatment of hypertension makes no recommendations for using home blood pressure monitoring as a strategy. However, it acknowledges evidence from observational studies that demonstrate that home blood pressure monitoring has a prognostic value equal to, or higher than, clinic-based blood pressure monitoring (Ministry of Health, 2018, p.67). This, as demonstrated in the previous studies discussed, is likely due to the increased amount of time to monitor blood pressure and controlling for white coat hypertension. However, it does reiterate that any device used at home or in a clinic setting must be appropriately validated for use in pregnant women and comparable to measurements taken with a mercury sphygmomanometer (Ministry of Health, 2018, p.66).

In the studies discussed, all had similar features. They all focused on the implementation of home blood pressure monitoring for women who were either at risk of developing pre-eclampsia or identified as having a hypertensive disorder during pregnancy. They all used a device that was validated for use internationally in pregnant women, and women were educated by a specialist midwife, or clinic nurse or midwife of the correct method of use. All had a clear protocol for what blood pressure values were normal or abnormal, clear guidance for follow up per local hypertension guidance, and what the woman had to report immediately to her maternity carer. Of the one qualitative study focusing on participant's experiences, women found monitoring their

blood pressure at home with support from maternity carers to be empowering, anxiety-reducing, and an acceptable element of their health care.

## 2.7 Summary

Handheld Dopplers, blood pressure monitors intended for use in the home environment, apps, ultrasounds, and telemedicine all have acceptability for pregnant women during their pregnancies. The use of such technologies is a way for pregnant women to feel empowered about their unborn baby's health, as well as their own. A significant number of New Zealand women own or have access to a smartphone or other internet-capable device and use these technologies as part of their pregnancy journey. This technology use is usually as an adjunct to midwifery care but is often one of the resources she will access before speaking with her midwife. The concern lies in the quality and evidence-based content included in ICTs accessed by pregnant women, security of health data of the user, and false advertising, which could lead to harm via incorrect advice or breach of privacy.

There is some research internationally to suggest that the use of validated home monitoring technologies at home is safe, effective, and acceptable to both clinicians and pregnant women. This is particularly evident where telemedicine has been employed as part of both low-risk or high-risk obstetric care. Pregnant women are involved with monitoring multiple aspects of their and their unborn baby's well-being at home. Women's views, and their right to informed choice, should be taken into account when considering the use of monitoring technologies, especially when initiated by the woman.

The next chapter discusses the methodology chosen for this study and outlines how the study was undertaken.

## Chapter 3: Methodology

### 3.1 Overview

This chapter focuses on the rationale behind the chosen methodology and research design. An overview of the clinical issue prompting the study is discussed, followed by the context of qualitative research within health care disciplines. The Qualitative descriptive methodology is introduced, and its fit with the research issue is discussed. Finally, the study design, data collection, and data analysis strategies are outlined.

### 3.2 Methodology selection

To focus on the use of handheld fetal Dopplers by pregnant women, the qualitative descriptive methodology was chosen. Qualitative descriptive is a methodology in its own right which is employed to investigate complex phenomena as encountered by health professionals, patients, and those in health policy in order to develop a straight-forward, data-near, description of the phenomena or to refine what is already practiced (Sandelowski, 2010).

The question asked in this study is what factors are driving pregnant women to purchase or borrow and use a fetal heart rate monitoring device. Specifically; why they are choosing to use a handheld fetal Doppler, how they are using the device, and what information and supports underpin their decision-making.

Phenomenology was considered during the early study design phase for the exploration of the meaning of the lived experience of women using their own fetal heart rate monitoring devices, however the choice to use Qualitative Descriptive methodology with thematic analysis in this study was made from a pragmatic decision around the small scale of the study, the need for a broad overview of women's experiences, and time constraints of a master's level thesis, which would have made the Phenomenology methodology a poor fit for the context and scope of this study.

The Qualitative Descriptive methodology can have similarities to, and can borrow from, other qualitative methodologies, such as Grounded Theory and Phenomenology, however doesn't require the researcher to take a firm philosophical position; recognising that the methodology and the data generated are living entities, which may require the researcher to be reflexive depending on what the data is presenting to them (Sandelowski, 2000). That is not to say that Qualitative Descriptive studies lack theory or framework, but it recognises that the researcher has a

theoretical position at the commencement of their study and should be willing to move from that position should the investigation warrant it instead of trying to make their data fit a more rigid research theory or framework tradition which may result in the data losing validity or meaning (Sandelowski, 2010).

### 3.3 Use of handheld fetal Dopplers by pregnant women: What is the problem?

The issue of pregnant women using handheld fetal Dopplers was first described in 2009, when a case report in the British Medical Journal linked the use of the device to a stillbirth from the pregnant woman receiving false reassurance by relying on the Doppler. Untrained use of a handheld Doppler, argued the authors, carries risk to the unborn baby and pregnant woman through delayed presentation for concerns of fetal wellbeing, and false alarm from inexperience (Chakladar & Adams, 2009). Commentary in the British Journal of Midwifery noted that handheld fetal Doppler monitors were for fun and bonding, but the use by pregnant women forsakes the expertise of health professionals and puts them and their unborn baby in peril (Daniel, 2009). However, these concerns do not highlight the how's and why's of handheld fetal Doppler use and fail to take into account the views and experiences of pregnant women. Without this knowledge, it is difficult to understand what reasons women have for seeking to use handheld fetal Dopplers, and how to balance health professional concerns with those of pregnant women.

The experience and views of pregnant women in this space is absent from qualitative studies of fetal monitoring, and at the planning stage of this study there were no published studies of pregnant women's use of handheld fetal Dopplers. As this is a novel line of enquiry, a broad approach focusing on the pregnant woman's account was needed. Therefore, qualitative descriptive methodology utilising individual interviews as the data collection method and thematic analysis as the data analysis method was selected.

### 3.4 Qualitative research

Qualitative research seeks to interpret the meaning people attach to their experiences of the social world and how they make sense of it by observing those experiences and meanings in their naturalistic setting. It lies within a positivist paradigm, where the human experience is able to be measured and explored scientifically with language, rather than numbers (Mazlish, 1998). Early positivist philosophers during the Enlightenment noted that lived experiences were too complex to be measured using mathematical analysis, but that inductive reasoning based on observation and building on knowledge through experience was, indeed, a science as valid as quantitative sciences (Brinkmann, 2017). This inductive reasoning follows set laws and practices, with

communities needing to accept principles of a method, yet positivism also encourages emergent methods where there are emergent phenomena (Mazlish, 1998).

#### 3.4.1 Qualitative health research

The use of qualitative research in health care settings focuses on the experiences of those involved as patients or practitioners. However, qualitative health research is seen as the poor cousin of quantitative health research, with the idea of evidence-based medicine firmly entrenched in quantitative measures of effectiveness of treatment and cost-benefit (Mays & Pope, 2020). Unlike quantitative research, qualitative studies can provide rich insights into the lived experiences of certain aspects of health, particularly from the view of the patient, which in turn can generate new understandings of particular aspects of care. Establishing qualitative rigor, therefore, is a process of establishing credibility, transferability, dependability, and confirmability.

According to Guba & Lincoln (1989), credibility is established when co-researchers and readers can identify and recognise the experience presented by the description. A decision trail, therefore, is essential for an audit of the events, influences, and actions undertaken by the researcher should a reader question the credibility. This self-awareness is encouraged through field journals, peer examination, peer-debriefing, and member-checking by the study participants (Koch, 2006; Thomas & Maglivi, 2011). This also establishes dependability and confirmability via describing the purpose of the study, the rationale of participant selection, data collection method, data analysis, interpretation of the findings, and discussing methods of establishing credibility (Thomas & Maglivi, 2011).

Transferability is the qualitative equivalent of the quantitative external validity, where findings or methods are able to be transferred from one group to another (Thomas & Maglivi, 2011).

Providing a description of the demographics and geographical area of the study, which in turn informs the fit and applicability of the research to practice (Thomas & Maglivi, 2011).

#### 3.4.2 Qualitative description

As discussed previously, the qualitative descriptive methodology as described by Sandelowski (2000) seeks to present a summary of an event in everyday terms and remain near to the data on interpretation.

According to Kim, et al. (2017), well-designed qualitative descriptive studies have six features which define the methodology;

1. it draws from naturalistic enquiry and studies phenomena in its natural state;

2. is less theory driven to facilitate flexibility in theory and framework design;
3. uses individual or small group interviews using a minimal or semi-structured interview guide;
4. uses purposeful sampling techniques to gain broad insight and rich information from data;
5. aims for minimal transformation and low-inference of the data in the analysis stage;
6. and represents findings in a straightforward and comprehensive manner that makes sense to the reader.

The qualitative descriptive methodology is ideal when the study is small, constrained by time, and requiring a straightforward analysis of the data to create a nuanced and thoughtful overview of the participants experiences (Smythe, 2012).

### 3.5 Study design

#### 3.5.1 Participants

Initially, primiparous women with a singleton pregnancy were identified as an appropriate group to study given the differences that women who have had previous children may have from their experiences. However, on reflection, including multiparous women and their lived experiences would enrich the data and provide a greater overview of the use of handheld fetal Dopplers by pregnant women.

All women were recruited from one geographical area of New Zealand, and interviews took place at a location of their choice. For most, this was their home. One participant chose a café, and one was an inpatient in hospital so was interviewed at the bedside by her choice.

As qualitative studies focus on smaller sample sizes, a recruitment number of between six and ten was estimated to gain a comprehensive overview of the use of handheld Dopplers in pregnancy. A total of six pregnant women were recruited and interviewed.

#### 3.5.2 Inclusion criteria

The initial inclusion criteria were:

- Self-identified use of a handheld Doppler during current pregnancy;
- Primiparous (currently pregnant in first ongoing pregnancy or have birthed a live or stillborn baby in the last 12 months in their first ongoing pregnancy);

- singleton pregnancy;
- woman aged over 18, English speaking, residing in the Greater Wellington Region.

The inclusion criteria were changed to include multiparous women eleven months after ethics approval was granted due to lack of participants.

### 3.5.3 Interview guide development

When considering the overall question of what factors were driving pregnant women to buying or hiring fetal monitoring equipment, a semi-structured interview guide was developed asking women about when in their pregnancy they decided to get a device and how they got one, how they learnt how to use it, what advice they were receiving around device use, and how they felt about using the device. The aim of semi-structured interviews is to “encourage participants to talk freely about all the topics on the guide, and to tell stories in their own words” (Polit & Tatano Beck, 2012, p.537).

Demographic questions were also asked regarding their age, education level, marriage status, and ethnicity.

### 3.5.4 Ethics

Ethical approval was sought and gained from the Victoria University of Wellington Human Ethics Committee (HEC) on 23<sup>rd</sup> September 2018, ethics number 0000026360. A scope of review was submitted to the New Zealand Ministry of Health, Health and Disabilities Ethics Committees (HDEC) in June 2018. It was decided by the Commissioner that this study was out of scope and therefore not required to have ethics approval from HDEC. The ethics of this study were also informed by the Code of Conduct<sup>7</sup> and Code of Ethics<sup>8</sup> for midwives as prescribed by the Midwifery Council of New Zealand and the New Zealand College of Midwives, especially around professional conduct as a midwife undertaking research, and around privacy of participants and their data which was collected for this study.

Principles of the Treaty of Waitangi were also applied by acknowledging tangata whenua (people of the land), especially if they use Te Reo Māori language in their responses by honouring those words and faithfully reproducing them within any transcripts or quotations thereof. Manaakitanga (generosity), kaitiakitanga (guardianship), whai mātauranga (knowledge and understanding), and

<sup>7</sup> <https://www.midwiferycouncil.health.nz/Public/06.-I-am-a-registered-midwife/1.-Standards-of-Clinical---Cultural%20Competence---Conduct.aspx>

<sup>8</sup> <https://www.midwife.org.nz/midwives/professional-practice/philosophy-and-code-of-ethics/>



whanaungatanga (shared relationship) were also fostered by inviting participants to request a copy of their transcript with invitation to review and make corrections as they deem necessary, and by sharing the completed published work if requested by the participants.

Due to difficulty in recruiting for this study, a request for variation of the inclusion criteria to include multiparous women was sought. Variation to the inclusion criteria was granted on 23<sup>rd</sup> August 2019 under the same ethics number.

Ethical considerations for this study focused on the potential for participants to be exposed to psychological harm. The risk was considered minimal, with the risk being some participants may find recounting their experience emotional during or after the interview. Participants were provided with avenues to contact their General Practitioner (GP) or Lead Maternity Carer (LMC), as well as contacts to crisis and grief counselling groups such as Lifeline New Zealand, and Skylight.

Informed consent was gained from the participants prior to interview. Participants were provided with the information sheet at point of first contact and self-selected their participation by consenting to be interviewed. Participants were informed that they could withdraw from the study at any time during the study period.

Anonymity was ensured by assigning each participant a pseudonym and redacting names of their midwives or significant others if they were mentioned within the transcript. Confidentiality ensured by password protection of electronic documents and storing hard copies in a lockable cabinet located in my home. Data will be kept secure for five years, after which it will be securely destroyed. In keeping with confidentiality, only myself and my research supervisor have access to the data during the study period.

### 3.6 Data collection

#### 3.6.1 Participant recruitment

Participants were approached via their Lead Maternity Carer midwives, and in one case via a core midwife<sup>9</sup>. Information about the study and posters inviting participation were shared with midwives, both LMC and core, practicing in the geographical area of the study inclusion criteria via social media, discussing the study and inviting them to share with women in their caseload who had discussed that they were using a handheld Doppler during their pregnancy. The midwives then could either share the women's contact details with consent, or encourage the woman to contact

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<sup>9</sup> A core midwife is one who is employed by a District Health Board or a privately-run birth centre to provide the day-to-day inpatient maternity care across the antenatal, intrapartum, and postnatal periods.

myself directly. I would then make contact with the woman via phone to discuss the study, and book a time to conduct the interview at a location of the woman's choosing. The participant information sheet and consent form were emailed to the woman prior to the interview, and revisited prior to the commencement of the interview.

Other avenues of recruitment were attempted via well child nursing providers, antenatal class providers, and social media groups for pregnant women living in the geographical area of the study inclusion criteria with little success.

Participants were informed that interviews would take place in person, in a location of their choosing, and would take up to 45 minutes (see Information Sheet Appendix 2).

### 3.6.2 Interviews

Audio recordings of the interviews were made using the Livescribe 2GB Echo pen<sup>10</sup>. Field notes were kept using a Livescribe notebook<sup>11</sup>. Backup audio recording was made on an iPhone 7, with recordings password protected. As there were some specific questions that were to be asked, a semi-structured interview guided by an interview schedule was employed.

Semi-structured interviews focus on specific topics the researcher needs to cover, particularly when they know what they wish to ask, but not what the answers may be. The interview schedule derives from these specific topics or questions, and the role of the researcher or interviewer is to encourage participants to speak to the topics and tell their story in their own words.

In this case, understanding how each woman discovered that they could purchase or hire a handheld fetal Doppler, their reasons for using it, and how they learned how to use it was the direct focus of the study. The interview schedule focused on these questions, with cues to elaborate further during the interviews.

### 3.7 Data analysis

Interviews were transcribed verbatim from audio recordings made via the LiveScribe software. This was an arduous process due to being a novice in the skill of transcribing, and by only having a single laptop and screen available to be able to switch between the LiveScribe software and Microsoft Word processor software. Due to the lag time of switching windows, and the difficulty of using two software windows side-by-side, the interviews were initially transcribed by hand and

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<sup>10</sup> <https://us.livescribe.com/collections/smartpens/products/2gb-echo%E2%84%A2-smartpen-3>

<sup>11</sup> <https://us.livescribe.com/collections/paper/products/single-subject-notebook-4-pack-1-4>

then typed to reduce the lag time and loss of flow that switching between program windows caused. The handwritten copies of the transcriptions were then stored with the hard copies of the consent forms, and the soft copies stored under password protection per data security measures. The participants were offered their transcripts for checking. Two out of the six participants indicated interest in receiving their transcripts, but neither responded to the email inviting them to discuss their interview transcript.

### 3.7.1 Thematic analysis

To analyse the data collected through a Qualitative Descriptive study, Thematic Analysis, as described by Braun and Clarke, was applied. Thematic Analysis, like Qualitative Description, is a flexible method and is useful for identifying and reporting patterns of themes in data, as well as interpreting those themes within the data (Braun & Clarke, 2006). It can be used as a realist method, to reflect the lived reality of the participants, or as a contextualist method, to apply further context of wider systems on the reality of the participants without losing focus on those realities (Braun & Clarke, 2006). Once the data have been collected, the process of Thematic Analysis follows six phases (Braun & Clarke, 2006, p.35);

- 1) Familiarisation with the data: this required transcription of the interview recordings, and re-listening and re-reading to the interview recordings and transcripts, and writing down initial thoughts and ideas about the data.
- 2) Generating initial codes: systematically coding and collating features of the data across all six transcripts. This involved multiple readings and listening of the transcripts and recordings, with codes generated including “feels anxious”, “LMC relationship – negative”, “LMC relationship – positive”, and “woman-fetus relationship”
- 3) Searching for themes: using the codes collated to find patterns, and then theming them together.
- 4) Reviewing themes: seeing if the themes worked within the coded extracts of data, and across the data set as a whole.
- 5) Defining and naming themes: continuing the analysis and refining each theme, as well as the narrative of the analysis. For example, “feels anxious” was refined in to the theme of “Control”, with subthemes relating to specific anxieties that required a response from each woman.

- 6) Producing the report: analysing the themes, codes, and overall narrative, and relating back to the research question, and literature review, to produce the findings and discussion chapters of this thesis.

The use of thematic analysis within qualitative descriptive methodology provides an auditable trail to provide structure to the analysis of the data, and by reviewing the themes against the data it keeps to the data-near imperative of qualitative descriptive methodology. The thematic analysis is presented in the following chapter, producing the results of the study.

## Chapter 4: Findings

### 4.1 Introduction

The five main themes and subthemes that emerged from the thematic analysis will be discussed in this chapter. *Control* was a strong overarching theme, with five of the six women expressing explicitly that a need to control their anxiety around their pregnancy was the deciding factor of their obtaining and using a handheld Doppler. This was further broken down in to the subthemes of *Fertility and Pregnancy Loss*, *Ultrasound anxieties*, and *Doppler anxieties*. *Fetal feedback* also represented a strong theme, with the subtheme of *Bonding*. The theme of *Peer-to-peer education and support* was also very clear, as all of the women utilised their peer networks online to inform their use of a Doppler during their pregnancy. *Lay knowledge versus professional knowledge* was also apparent, with the women identifying that they felt they held a different level of understanding about handheld Doppler use to their Lead Maternity Care<sup>12</sup> midwife. A subtheme of *Lack of research* in the use of dopplers was also present. The *Woman-Midwife relationship* was the final theme, with a subtheme of *More support*, with the women identifying that their relationship with their LMC midwife was also an essential support for them and wanting more information around use of handheld dopplers during pregnancy. The six women who participated in this study, when named, are identified by a pseudonym to anonymise their identity.

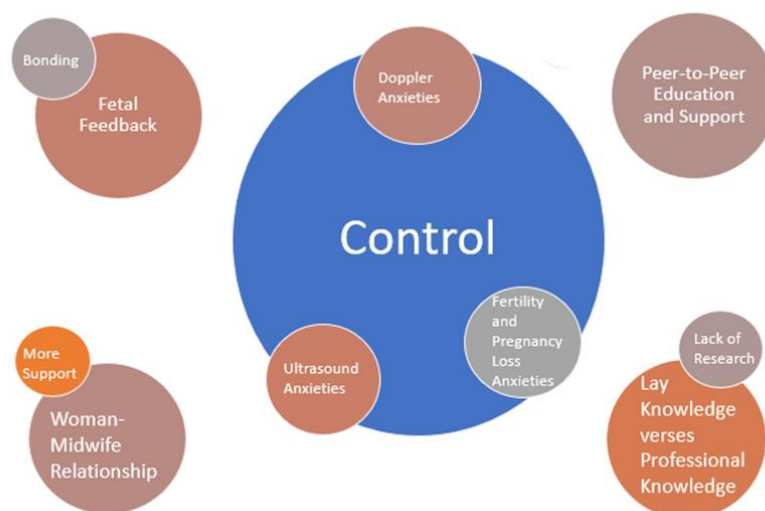


Figure 4: Thematic Map

<sup>12</sup> In New Zealand a Lead Maternity Carer, abbreviated to LMC, denotes the clinician who a woman has engaged to be her primary care provider during her pregnancy, labour and birth, and postnatal periods. This can be a Midwife, a General Practitioner (GP), or an Obstetrician who provides primary maternity care as part of their practice. This is outlined in Section 88 of the New Zealand Public Health and Disability Act (2000).

#### 4.1.1 The Participants

The six women who were interviewed for this study all lived in a major New Zealand city and were between 20- and 39-weeks' gestation at time of interview.

Laura, aged 20, was in a defacto relationship with her partner. She identified as New Zealand European<sup>13</sup> and had completed high school in New Zealand. This pregnancy was her third, having had two previous miscarriages.

Elvira, aged 41, was married. She identified as European and held a postgraduate degree. This was her first pregnancy, which was conceived via in-vitro fertilisation.

Georgie, aged 29, was married. She identified as European and held a tertiary-level diploma. This was her first pregnancy.

Ngaire, aged 27, was in a defacto relationship with her partner. She identified as both New Zealand European and Māori and held a tertiary-level diploma. This was her first pregnancy.

Ruby, aged 24, was in a defacto relationship with her partner. She identified as New Zealand European, and held a tertiary-level diploma. This was her second pregnancy, having had a previous miscarriage.

Zuzanna, aged 44, was married. She identified as European and had completed high school in her country of origin. This was her third pregnancy, having previously miscarried due to an ectopic pregnancy, and suffered the loss of her unborn baby in the third trimester. All three of her pregnancies were conceived via in-vitro fertilisation.

The direct quotes from each woman are italicised and attributed where relevant.

#### 4.2 Control

The strongest theme that emerged was that of control, particularly to manage the state of anxiety that the women felt as a negative and overwhelming part of their pregnancy journey. Pregnancy in general signalled a time of heightened anxiety for the participants, either because they had never been pregnant before and *"couldn't recognise some signs"* of an ongoing pregnancy, or because they had previously experienced infertility or pregnancy loss. Some of the participants self-identified as being *"very anxious"* due to these unknowns or previous experiences, and sought a

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<sup>13</sup> A person born in New Zealand of European descent, also known as Pākehā in te reo Māori.

way to control these anxieties, particularly prior to the quickening<sup>14</sup>. Elvira, pregnant for the first time, described the quickening of her baby as *“like a little gas or something”*, which she initially didn’t recognise as fetal movements. She had been using a handheld Doppler prior to this point of her pregnancy, so that she could *“know in the beginning that everything [is] fine with the baby”*. There were various reasons that the women identified as causes of this feeling of anxiety that required a response to gain some control over, and these were identified as subthemes.

#### 4.2.1 Fertility and Pregnancy Loss anxieties

Anxiety stemming from struggles with fertility and previous pregnancy losses via miscarriage or stillbirth was a primary factor for the use of handheld dopplers for participants in this study. This feeling of having a precarious pregnancy<sup>15</sup> was not easily managed by any measure other than being able to hear the heartbeat of the unborn baby. For Laura, the youngest of the participants at age twenty, *“being young and not being able to have kids, like, as easy as everyone else could is a big thing for me.”* On her third pregnancy, with two prior miscarriages, Laura felt anxious, even more so when her pregnancy turned high risk following the diagnosis of oligohydramnios<sup>16</sup> prior to twenty weeks gestation. Having a handheld Doppler meant that she could feel in control of her anxiety around this diagnosis by knowing *“it’s still alive”*. Laura was very aware that using a handheld Doppler at home *“was never going to change the outcome [of the pregnancy] but it’s made me feel better going through all this”*, which was ultimately her aim for using the Doppler. For Elvira, her first pregnancy was the result of in-vitro fertilisation<sup>17</sup>, with her anxiety stemming not only from being a first-time mother, but also from the process to become pregnant via artificial reproductive technology: *“[there are] a lot of feelings involved and so when the things – the emotions that you cannot control... so I think... you cannot actually control anything in your pregnancy.”* The need to have *“a little bit of control”* over her anxiety and her view of the nature

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<sup>14</sup> Quickening refers to the time where a pregnant woman first feels fetal movements, usually around 19 weeks gestation for a woman in her first pregnancy, and as early as 16 weeks for women who have had previous pregnancies (Grigg, 2015).

<sup>15</sup> A precarious pregnancy is where the woman is highly anxious about the chance of miscarriage, usually due to their previous experience of infertility or pregnancy loss (Middlemiss, 2020).

<sup>16</sup> Oligohydramnios means that the amount of amniotic fluid (water) around the unborn baby is considered abnormally low. This can be associated with abnormalities of fetal growth and organ development (Baddock, 2015).

<sup>17</sup> In-vitro fertilisation, abbreviated to IVF, is one of the assisted reproductive technologies that can help a woman to become pregnant where conception has been unsuccessful or is unable to occur. In the case of IVF, fertilisation of the egg (ovum) occurs outside of the body, with sperm injected directly into the egg in order for fertilisation to occur. After a few days of incubation, the fertilised egg (zygote) is put into the uterus of the woman. The term *in vitro* comes from Latin, meaning *in the glass*. Colloquially, babies resulting from IVF have been called ‘test tube babies’. (Baddock, 2015).

of pregnancy being uncontrollable in general prompted Elvira to purchase a handheld Doppler to use during her pregnancy.

Zuzanna, the eldest of the participants at age forty-four, required IVF to become pregnant all three times, but lost her first pregnancy due to an ectopic pregnancy<sup>18</sup>, and her second pregnancy sadly ended when her unborn baby had died from a cord accident<sup>19</sup> during the third trimester. As her third pregnancy occurred within months of her unborn baby's death, she felt *"it would be better to have my own [Doppler]"* as the stress her anxiety caused was too great for her to manage using other strategies. She did not feel that *"calling the midwife and asking her to check it"* was a viable option due to the frequency and timing of the stress the anxiety was causing and the need to alleviate it. For Zuzanna, the ability to alleviate her anxiety as it was occurring was essential, especially as she felt she *"couldn't stress like this at my work [as a caregiver]"*. Anxieties around experiences with fertility and pregnancy loss was a primary driver for participants to use a handheld Doppler at home, especially as it was a strategy that they could employ to self-mediate these feelings on an as-needed basis.

#### 4.2.2 Ultrasound anxieties

For two of the participants, the lead up to an ultrasound was a source of anxiety, as previous pregnancies had been diagnosed as missed miscarriages<sup>20</sup> on a routine ultrasound scan prior to twenty weeks gestation. Laura, having had two previous miscarriages diagnosed this way, described this feeling as a *"big fear of ultrasounds"*, especially around a repeat of being told that *"there's no heartbeat anymore"*. This fear meant that she felt she could not enjoy seeing her unborn baby on ultrasound as she felt other women could. Being able to use a handheld Doppler at home prior to attending an ultrasound meant that she *"could have no anxiety going into it and I'd actually look forward to it"* as she had heard the heartbeat prior, and felt some form of control over the possibility of a shock diagnosis of another missed miscarriage. Ruby, pregnant for a second time following a missed miscarriage at 14 weeks gestation previously, also described using a handheld Doppler for this purpose: *"picking [the fetal heartbeat] up on the Doppler before we had my second scan this time, I felt a bit less anxious going into the scan room."* Ruby described

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<sup>18</sup> An ectopic pregnancy is where the pregnancy develops outside of the uterus, usually in the fallopian tube. If not managed prior by removing the pregnancy, it can rupture and cause catastrophic bleeding in the pregnant woman. (Thorogood & Donaldson, 2015).

<sup>19</sup> Umbilical cord accident refers to a fetal death caused by the umbilical cord not functioning due to disruption of blood supply, usually due to compression. (Collins, 2014).

<sup>20</sup> A missed miscarriage is when the fetus dies prior to twenty weeks gestation but is retained. Women may experience a range of signs, such as vaginal discharge or a ceasing of breast changes, or none at all. (Thorogood & Donaldson, 2015).



herself as feeling *“absolutely terrified”* prior to her first scan in her second pregnancy, dreading another miscarriage diagnosis.

#### 4.2.3 Doppler anxieties

Conversely, as much as having a handheld Doppler could alleviate anxiety, they could also be a cause for anxiety. Being unable to locate the fetal heart, not understanding what the sounds being heard meant, and the anxiety around the possibility of self-diagnosing a miscarriage or fetal death were all quite strongly articulated by participants. Laura described *“only ever one time where I couldn’t find [the fetal heartbeat]”*, where she *“was freaking out”* as it took longer than previous to locate the fetal heartbeat. *“I thought ‘oh my God, I can see why people don’t recommend them now”*, although she did continue to use the handheld Doppler following this event.

Ngaire, pregnant for the first time, described that her knowledge gap about the normal fluctuations of the fetal heart, particularly in relation to fetal movement, *“freaked me out at first”*. She also described a time where a change in fetal position meant that she couldn’t find the fetal heartbeat on her Doppler as she had previously and rang up her midwife *“in tears going ‘I can’t find him’”*. Her midwife was able to reassure her and give her the information she was missing regarding fetal positioning. For Ngaire, the Doppler *“becomes that thing that can ease your anxiety, but it often doesn’t really”*.

Zuzanna described using a handheld Doppler as *“stressful”* each time, as she would constantly worry if *“there [is] going to be [a heartbeat] or not?”*. The stress of not finding a heartbeat was a concern, however the ability to ultimately hear the unborn baby’s heart beat overrode those stressors, and Zuzanna particularly felt that she *“would rather go with [the Doppler] than without it”* due to the overall alleviation of anxiety it could provide. Despite the stress that using a handheld Doppler could produce, participants continued to use them despite this as the overall benefit of reduced anxiety and sense of control was greater than the possibility of discovering that their unborn baby had died.

#### 4.3 Fetal Feedback

For the participants in this study, a desire for some sort of feedback from their unborn baby was a driving factor in choosing to use a handheld Doppler. Georgie, pregnant for the first time, described this need for feedback, especially after her pregnancy symptoms *“just went away and I felt normal again”*. At that moment in her pregnancy she *“wasn’t showing, I didn’t really feel much”*, and needed some form of reassurance to know that she had an ongoing pregnancy

between the time of her nuchal translucency scan at twelve weeks gestation and her anatomy scan at twenty weeks gestation. *“That was my purpose of getting [the Doppler] in the first place, was just to have the feedback but now I get the feedback in the form of movement and kicks.”*

Following the quickening, Georgie felt that she was able to reduce her use of the Doppler, as feedback from her unborn baby was now in a more tangible form of noticeable movement.

Ngaire *“was quite freaked out”* when she found out she was pregnant and *“wanted a way to kinda make myself feel connected”*. She described the earlier gestations of her pregnancy as *“nothing really going on, you just feel crap”*, relating to the morning sickness and exhaustion she felt during that time. Using a handheld Doppler was a way of coming to terms with unexpectedly being pregnant and navigating the symptoms of early pregnancy to feel reassured that her unborn baby was present.

For Zuzanna, fetal movements were not an entirely reassuring sign. In her previous pregnancy that resulted in her unborn baby dying prior to birth, she was still feeling fetal movements even though it was suspected that her unborn baby had died during this period of what she felt were reassuring and normal fetal movements. In hindsight, *“[The unborn baby] was still kind of moving, it was not the baby’s moves, it was just the floating of the baby, so I wasn’t sure if it was proper movements.”* To have the ability to hear this unborn baby’s heartbeat was a way for Zuzanna to gain some extra trust in the presence of fetal movements, *“I knew that’s going to tell me whether the baby is alive or not... I kinda wanted the confirmation in a way even though I felt some small movements”*.

Even when it came to ultrasound scans, two of the participants expressed that missing out on hearing the fetal heartbeat due to the available equipment at their local radiology practice increased their desire to be able to hear the heartbeat. Ruby, *“terrified”* of ultrasounds due to her previous experience of missed miscarriage diagnosis in a previous pregnancy, needed the additional reassurance of hearing the heartbeat to put herself at ease during the ultrasound scans early in her pregnancy. This view was also shared by Ngaire, who stated she *“felt a bit gypped”* at not being able to hear her unborn baby’s heartbeat and felt this was also a factor for her *“using [the Doppler] a lot more... like, more than I probably would have”*.

#### 4.3.1 Bonding

A part of the desire for fetal feedback is a way to bond with the unborn baby. The women described this opportunity as *“special”*, especially as the handheld dopplers often allowed them to listen to their unborn baby’s heartbeat on their own terms, in a private environment outside of a

clinical setting, and to share the experience with family members and friends that did not live close by.

Elvira enjoyed *“having this little moment where we could hear the baby’s heartbeat... and it’s just you and your husband”*, valuing the privacy and intimacy of hearing the fetal heart at home. Georgie’s husband was unable to attend midwife appointments with her, so using the handheld Doppler at home was *“really nice for him to get something, some kind of confirmation, reward, or cool thing out of it.”* Ngaire felt that using a handheld Doppler was *“a whole lot less invasive than the [ultrasound] scans”*, as it was just herself and her partner present, and also valued the privacy to listen in at home in her own time. For Ruby, using a handheld Doppler was a way to refocus *“if you’re going through a bad day”*, describing hearing the fetal heartbeat as *“relaxing”*. This desire for feedback from the unborn baby, prior to quickening, was a factor that drove the women towards using handheld fetal dopplers at home. It also had the added value of providing a way to bond with the unborn baby early in pregnancy, particularly when the women felt a need for connection in a time when their symptoms were overwhelming, and as a way of including their partner in the pregnancy journey.

#### 4.4 Peer to Peer Education and Support

Every woman described accessing peer networks, mainly on internet sites such as YouTube and Facebook, as their main support and education tools to inform their use of handheld dopplers. Laura and Zuzanna specifically accessed peer-support sites for other women who had experienced miscarriages, pregnancy loss, and fertility treatment which lead them to discussions from other women who had used handheld dopplers during their pregnancies. This, in turn, informed their use of the devices. Zuzanna described making a connection with one of the other women on the support page, *“she was the one who told me about this, that such a thing exists and I think I probably was talking to her more than I spoke to my midwife about [the Doppler]”*. This peer-support was vital for Zuzanna, as she felt that having a friend who had gone through a similar experience and being able to talk informally about it to her would be more accessible than continuously contacting her midwife when she needed reassurance that was not about clinical midwifery matters. Laura felt that on her support groups, mainly based in the United States of America, *“there were heaps of chicks pretty much choosing [Dopplers]”* to alleviate and control their anxieties around miscarriage. She also accessed YouTube where other women who had used handheld Dopplers during their pregnancies posted videos discussing and showing how to use them. Elvira, too, also accessed YouTube; *“nobody actually explained to me, apart from seeing*

*some YouTube videos of some people who has this [brand Doppler], and how they were using [it].”* Ngaire also accessed YouTube, *“mostly cuz I really needed to hear what I was looking for”* and she felt that her sister’s demonstration of how to use a handheld Doppler was not correct.

The majority of the women were linked into Facebook groups with other women who were also due to give birth in the same month as them, and this also informed their decision to use a handheld Doppler. Discussions on these pages around handheld Dopplers would focus on people sharing their own experience of using a Doppler, people thinking about using a Doppler, or people dissuading others from doing so. Ngaire elaborated on these discussions:

*“Whether or not to buy one. Most people will say no, don’t buy one cuz it can cause you huge amounts of anxiety if things go wrong, which it does. You’ll have the odd people saying just make sure you learn how to use it and then you’re ok. And there’s always recording, like does this sound like a horse or a train cuz one’s more likely to be a boy or a girl apparently, but it’s not! Yeah, mostly just people’s recording. I think people got a bit sick of repeating themselves with the same questions like “should I buy one? Its real cheap”*

Elvira’s main concerns lay in ensuring she purchased a handheld Doppler that was fit for purpose, so she relied on product reviews online; *“they reviewed saying the machine worked fine, that they could find the heart beat very early stage of the pregnancy, and when they were comparing to other heartbeat monitor, that they preferred this one to that one...”*. Peer-to-peer support and education was the main method of information that the women used to inform and support their use of handheld Dopplers during their pregnancy.

#### 4.5 Lay Knowledge versus Professional Knowledge

As discussed previously, peer-to-peer knowledge sharing was the main form of education that the women had around deciding on and learning how to use handheld fetal Dopplers. However, the women also developed their knowledge of how to use a Doppler and what they were listening for from a variety of sources. Georgie, through her professional background, already understood *“the difference when [auscultating] my heartbeat versus baby’s heartbeat”*, and she combined this knowledge with peer-developed resources on Facebook, with observation of her midwife auscultating the fetal heart at their antenatal appointments. Ngaire described her unborn baby’s heartbeat as sounding *“like a horse or train, you can definitely tell it is the baby’s heartbeat... it goes up and down like you wouldn’t believe... my heartbeat doesn’t do that”*. Each woman also explained that auscultating the fetal heartbeat was *“only a glimpse in the moment”*, and had

strategies around if their concern was their own anxiety that could be controlled via listening to their unborn baby's heartbeat, or if there was a greater concern that required consultation with their midwife. Besides attending regularly scheduled midwife, obstetric, and ultrasound appointments, the women articulated the importance of seeking help if there were concerns about their or their unborn baby's health. Elvira, particularly, felt that she didn't think that using a handheld fetal Doppler at home was *"a replacement or that you should not contact your midwife if you feel like something is not right"*, and that she would contact her midwife rather than default to her handheld Doppler if she had concerns. Despite the majority feeling confident in their ability in learning how to and in using a handheld Doppler, Zuzanna felt *"quite naïve"* in hindsight. *"I thought it would be very easy... because I watched my midwife doing it, and I didn't realise that she knew what she was doing so it was easy for her to find [the fetal heartbeat] straight away"*.

#### 4.5.1 Lack of Research

Whilst most of the women were satisfied with the information that they had found online to support their use of a handheld Doppler, Georgie expressed some concern that there was no scientific-based literature to support her decision-making. She explained that whilst she did rely on the experiences of others to form her decision, she did take their experiences *"with a grain of salt"* and was cautious with her approach to using a handheld fetal Doppler.

#### 4.6 Woman-Midwife Relationship

All six women in this study identified a midwife as being their LMC, with half also identifying having some form of shared care with a hospital obstetric clinic due to some risk factors present in their pregnancies. In terms of the woman-midwife relationship, five described their midwife as being somewhat supportive of their decision to use a handheld Doppler. Ruby described the support she received from her midwife in terms of identifying what sounds could be heard whilst using a Doppler. *"She tells me about the noises, when he's moving, and the heart rate obviously, and what he's doing inside"*, which Ruby stated was helpful for her as she could be more certain of what she was listening for. Elvira's midwife *"never mentioned anything against [the Doppler]"*, but they did have a plan around Elvira's parameters for using the handheld Doppler and what would trigger Elvira to contact her midwife rather than rely on the Doppler. Ngairé stated that her midwife had told her *"that's cool if you wanna use it but just be aware there is so much inside you that can create noise, that it's easy to mistake it for something that's not there and it's easy to get freaked out by things you might hear"*. She later did need to contact her midwife due to concerns around not being able to find the fetal heart, and her midwife was able to explain why which

offered Ngairé a greater understanding; *“now you basically have to find his shoulder blade to hear it whereas before you just find his body and hear it... You’d think the bigger they [the unborn baby] are the easier it is, but it’s actually not.”* For Zuzanna, her relationship with her midwife spanned both her current pregnancy, and her prior pregnancy in which her unborn baby died before birth. She felt that because of this shared experience and previous LMC relationship her midwife understood her reasonings for wanting to use a handheld fetal Doppler at home and was *“quite OK with it”*. Despite this, Zuzanna felt that there were times where she felt that some aspects of how she was feeling during this pregnancy was better discussed with her peers online *“because you don’t want to keep calling your midwife all the time”*.

However, Laura described quite an opposite experience with her first midwife. Laura was told by her first midwife not to consider using a handheld fetal Doppler, *“she felt like she’s the one that was skilled in using that kind of thing, that I shouldn’t be using it cuz I wasn’t, like, a medical professional”*. This made Laura *“feel a bit stupid”*, as she felt she could correctly identify what her unborn baby’s heart was supposed to sound like, and how many beats per minute was a normal fetal heart rate. Laura challenged this view, *“at the end of the day it’s going to make someone feel better about their baby and their pregnancy”* particularly if, like her, they had experienced the trauma of pregnancy loss. This was one of the factors that Laura identified as causing her to disengage from her first midwife and seeking a midwife that was more supportive of what Laura felt was essential for her emotional and mental wellbeing in this pregnancy. Laura felt that the response that midwives in general had to women using a handheld fetal Doppler at home was *“taboo”*, to the point that *“not really many midwives want to talk about it”*. Georgie, whilst having a midwife supportive of her choice to use a handheld Doppler, also came across other women in her peer groups who perceived negative responses from their own midwives. *“There were a couple who posted how their midwife just rolled their eyes or, yeah, were pretty negative about use of it”*, however Georgie did express that she could understand the midwife’s point of view on the subject from her own research and discussions prior to deciding to use a handheld Doppler.

#### 4.6.1 More Support

The subtheme that emerged from the woman-midwife relationship was the wish for greater support by midwives for the use of handheld fetal Dopplers. Georgie stated that while she understood the reasons why midwives are not supportive of the practice of pregnant women using Dopplers at home, felt *“it would be nice that if you choose to do it that they kinda help you figure out exactly what you’re looking for”*. This particularly was due to her own concern around

the lack of published scientific or medical literature available around the practice as discussed earlier in this chapter. Ngaire reiterated Georgie's view, adding that midwives could *"teach you how to use them so you do have more of a security"* rather than just relying on what could be sourced on YouTube or other forms online media. Laura, stating that she has *"really strong feelings"* around the potential benefits of using a handheld Doppler, would like to see hospitals hiring the devices out to women who had experienced pregnancy losses and supporting the practice as a way of supporting the mental health and confidence of women previously bereaved.

Whilst the women of this study sought information and support from their peer groups and online, they were also wanting a greater amount of support from their midwives despite feeling that midwives were not always supportive of the practice of using handheld fetal Dopplers at home.

#### 4.7 Summary

The ability to use a handheld fetal Doppler at home to hear the fetal heartbeat had value and meaning to the women in this study. Whilst the main aim of hearing the fetal heartbeat at home was to have control over feelings of anxiety about a precarious pregnancy, there were other benefits expressed by the women. The ability to hear the unborn baby's heartbeat, in real time and in the privacy of the home, was a way of gaining feedback from the fetus prior to the ability to feel movements following the quickening. For some of the women, they could control their fear of a potential diagnosis of miscarriage during an ultrasound scan by being able to hear the fetal heartbeat beforehand. For others, it was a way to come to terms with being pregnant, with the symptoms that they were experiencing, and with the unknowns of being pregnant for the first time. The women felt that use of the handheld Doppler aided bonding with their unborn baby, as well as being a way to help her partner to be involved in her pregnancy experience and build a relationship with their unborn baby, particularly if the partner was not able to attend appointments with her.

The women gained their information and support via peer-to-peer sources online, such as Facebook groups and other online message boards and YouTube. Most of the women felt supported by their midwife in their choice of using a handheld fetal Doppler to a degree, however they also expressed the need for greater support from midwives, particularly for education and support around use of Dopplers.

The following, and final, chapter will now discuss these findings in respect to the research question and conclude this thesis.



## Chapter 5: Discussion and Conclusion

### 5.1 Introduction

The use of handheld fetal Dopplers by pregnant women is poorly described in literature outside of a single case report from the UK in 2009. Use of a fetal Doppler was implicated in a stillbirth at 38 weeks gestation with little conclusive evidence that the stillbirth could have been avoided if the pregnant woman did not use the handheld fetal Doppler for reassurance (Chakladar & Adams, 2009). During the process of this study, a single qualitative study from the UK was published focusing on women's experiences of using handheld fetal Dopplers at home in the context of managing anxiety around miscarriage.

The literature review focused on qualitative literature focused on the experiences of women who have had their pregnancies monitored in both traditional outpatient clinics and via telemedicine, as well as the use of information technologies such as apps on smartphones and social media.

The pregnant women interviewed for this study primarily used handheld fetal Dopplers to control their feelings of anxiety around their pregnancy status, mainly if they had struggles with fertility or previous pregnancy loss, such as miscarriage or stillbirth. In using the handheld fetal Dopplers, women felt they could self-manage their anxiety during a period where there was no direct feedback from the unborn baby in the form of movement, and when midwife and ultrasound appointments were some weeks apart. This control also extended to managing the fear of the potential diagnosis of a repeat pregnancy loss diagnosed seen on the ultrasound scan, so that the women could allow themselves to feel a sense of enjoyment that they believe to be a reasonable response when attending a pregnancy scan. This control over anxiety was necessary for the women in this study. It meant they could find relief over an issue that was impacting their daily life in a way that was accessible to them as they needed it, rather than having access controlled via their LMC. There was a sense of not wanting to be a burden to their LMC over an issue that was more to do with a feeling of personal responsibility for the control of anxiety rather than a direct concern requiring midwifery assessment.

Secondary reasons the women had for using a handheld fetal Doppler were bonding with the unborn baby and being able to share aspects of the pregnancy with their partner, friends, and family. The women valued the privacy offered by handheld fetal Dopplers, in that they could listen to the heartbeat in their own home without the intrusion of a midwife, doctor, or ultrasonographer. They could share this private and intimate moment with their partner, particularly if he could not be present at appointments due to work commitments.



Women mainly used peer-to-peer sources to inform their use of handheld fetal Dopplers. These supports were based online, in communities with other women who had similarities such as being due in the same month, having undergone fertility treatment, or had experienced miscarriage and pregnancy loss. The women in this study perceived that discussions around the use of handheld fetal Dopplers were frequent amongst their peers online, as were shared recordings of the fetal heartbeat with the group. The women also identified using other peer-developed materials such as YouTube videos to refine their technique of use and to hear examples of sounds they could hear when using a handheld fetal Doppler.

These will now be discussed in greater detail about chapter four's findings over the next sections: control and the precarious pregnancy, bonding with the unborn baby, self-monitoring, and online peer communities.

## 5.2 Control and the Precarious Pregnancy

In her research in pregnant women in the UK who chose to use handheld fetal Dopplers in pregnancy, sociologist Aimee Middlemiss concluded that it is an attempt to “control anxiety about pregnancy outcome through acquiring knowledge of the fetus in pregnancies perceived as at risk of miscarriage” (2020, p.162). These pregnancies were considered to be “precarious” due to the concern around the risk of miscarriage (Middlemiss, 2020, p.165). Women in Middlemiss' study expressed similar reasons for using handheld fetal Dopplers at home to women in this study. The need to feel prepared for the shock of miscarriage diagnosis on ultrasound scan, having a method to grant relief from the anxiety of the possibility of miscarriage, needing to feel in control of the uncontrollable aspects of pregnancy and loss, and not wishing to place extra demands on their care provider in both studies. Women in Middlemiss' study expressed that feeling unsupported by their care provider and needing to regain a sense of agency in the face of that perceived lack of support was a driver towards using a handheld fetal Doppler.

Conversely, women in this study expressed that their LMC was, in most cases, accepting and receptive to their choice. These perceived differences could be due to the model of care offered between the UK's National Health Service (NHS) – where women attend their local trust's maternity unit and may not always see the same midwife – and NZ's self-employed continuity model of care, where women are usually under the care of a known midwife or small group of midwives, with an emphasis on partnership inherent in practice standards. Despite these differences in the model of care, women in both studies expressed concern about being a burden on their caregivers. They felt they needed a way to self-mediate their state of anxiety (Middlemiss,

2020, p.174). The women in this study expressed that while they did find some support from their LMC, they wished that there was more support to aid their decision-making and receive their education around handheld fetal Doppler use from their midwife.

There is an undercurrent of fear – that the risk of a miscarriage, particularly a subsequent miscarriage, will happen. The statistics could justify those fears. Miscarriage occurs in approximately 15-25 percent of all pregnancies (Donnolley, et al, 2015, p.1218). For those who have gone through miscarriage, trust in the process of pregnancy and the woman's own body has been broken (Gerber-Epstein, et al, 2009, p.16; Côté-Arsenault & Donato, 2011, p.87). Those women who miscarry feel that control slipped following the discovery of miscarriage. That before that moment, they had control over their body, the pregnancy, and the experience of becoming a mother and after their body had betrayed them (Gerber-Epstein, et al, 2009, p.12). For trust in pregnancy and the woman's body to be re-established, there needs to be biomedical proof, an image of a live fetus on ultrasound, or the sound of the fetal heartbeat. It is not that there is a clinical concern that needs treatment or monitoring, per se; it is that trusting the process of pregnancy and the body is fraught with anxiety. That specific anxiety, therefore, needs a method to control it. The pregnant woman herself usually drives this mediation of anxiety and reestablishment of control.

On a societal and cultural level, Western societies already do not trust the process of pregnancy, a view that has stemmed from the increasing medicalization of pregnancy and childbirth since the 19th century (Lupton, 2012). For example, there are inherent cultural norms to keep the news of a new pregnancy to oneself and those closest until the end of the first trimester – 12 weeks gestation (Lou, et al, 2017, p.1323). Approximately 95 percent of miscarriages will have occurred by the 12-14th week of pregnancy (New Zealand College of Midwives, n.d.). By this point of the pregnancy, women in New Zealand have had at least one ultrasound and may have elected to undergo screening for some fetal abnormalities. Only once proof of a viable pregnancy has been achieved via these biomedical sources, and the risk of miscarriage reduces by reaching the end of the first trimester do pregnant women tend to publicly announce their pregnancy (Lou, et al, 2017, p.1324).

Needing fertility treatment and being considered of advanced maternal age creates anxiety around past inability to conceive, and a sense of running out of time to achieve the outcome of a successful pregnancy, which compound the view of the nature of pregnancy and the trust in the process (Carolan & Wright, 2017, p.150). This experience lingers in successful pregnancies as

anxiety around the possibility of the baby not surviving pregnancy (Netto Dornelles, et al, 2014, p.e118). Infertility, too, can impact in daily life and relationships with others, with some women feeling that they are an outsider due to not being able to successfully conceive and birth a live baby (Carolan & Wright, 2017, p.149). Both infertility and pregnancy loss can be traumatic, feelings that can last for years after the event, and repetitions of such trauma within the childbearing years can compound (Kendall-Tackett, 2005, p.63). These traumas, and societal distrust of the process of pregnancy, give rise to emotional cushioning.

Emotional cushioning in pregnancy is a mechanism that provides emotional self-protection from anxiety and the potential of emotional pain should another loss occur (Côté-Arsenault & Donato, 2011, p.82). The degree in which emotional cushioning occurs can depend on the level of anxiety experienced by the pregnant woman; the higher the anxiety, the more emotional cushioning (Côté-Arsenault & Donato, 2011, p.88). Pregnant women feel the need for biomedical proof of continued fetal life, but do not wish to be seen as ‘crying wolf’ by calling their midwife too often and running the risk of not having their concerns taken seriously (Côté-Arsenault & Donato, 2011, p.90). The women interviewed for this study did highlight that they felt they needed a way to abate their anxiety around the status of their unborn baby that did not involve continuously contacting their midwife. All they need is to hear the proof that their unborn baby’s heart was still beating.

### 5.3 Bonding with the Unborn Baby

Cranley posited the maternal-fetal attachment in 1981 as the pregnant woman engaging in behaviours that represent affiliation and interaction with their unborn child, thus establishing an initial unilateral relationship before birth and laying the foundations for attachment postnatally. These behaviours include the enjoyment of observing and feeling fetal movements, stroking the abdomen to elicit or respond to fetal movement, guessing at the unborn baby’s future temperament and personality based on fetal behaviours, feeling that the lifestyle changes of pregnancy are worth the effort for the unborn baby, imagining future caregiving activities, and maternal nesting behaviours (Cranley, 1981). Facilitators of the maternal-fetal bond include awareness of the unborn baby’s consciousness, the ability of the pregnant woman to communicate with her unborn baby, and support from the woman’s partner (Barrack, 2007). Factors that detract from the maternal-fetal bond include feeling unprepared for pregnancy, not knowing the sex of the unborn baby, and feeling anxious (Barrack, 2007). In a systematic review of 25 studies of maternal-fetal attachment, women who reported low levels of depression, a

supportive partner, and strong social relationships exhibited higher levels of maternal-fetal attachment (McNamara, et al, 2019). The impact of anxiety and stress, however, had mixed results in the studies reviewed, likely due to the multidimensional constructs of intrinsic and extrinsic factors (McNamara, et al, 2019). Factors such as having to undergo invasive diagnostic testing or being of advanced maternal age and the implications for fetal wellbeing might play a role in these mixed results, as these may be short-lived concerns and resolve as the pregnancy progresses (Berryman & Windridge, 1996). This emotional cushioning, as described in section 5.2, could also be a factor to inhibit maternal-fetal attachment, especially in the context of previous miscarriage and stillbirth.

For expectant fathers, while missing on the physical changes of pregnancy that women experience, they still describe similar facilitators and detractors for bonding. These include being able to interact with their unborn baby as positive factors, and feelings of fear and anxiety as inhibitors (Barrack, 2007). Therefore, maternal-fetal attachment plays a vital role in maternal mental wellbeing through pregnancy and into the postnatal period. While in this study, the women's partners' views were not examined, the women interviewed did express that including their partner in the act of hearing their unborn baby's heartbeat was an essential aspect for them. The partner's ability to hear the unborn baby's heartbeat was a way of creating an opportunity to bond as a family and share the experience of pregnancy without the third party of a midwife, ultrasonographer, or doctor mediating the experience outside of the intimate environment of the home. For the woman, the self-reported anxiolytic effect of hearing the fetal heartbeat before the tangible awareness of fetal movements when quickening occurs is an extension of these maternal-fetal attachment behaviours, particularly when these anxieties threaten their ability to bond with their unborn baby.

#### 5.4 Self-monitoring

Self-monitoring is usually a self-reflexive exercise in which a person with a specific interest in aspects of their health and wellbeing records and acts upon data generated from their lived experiences. This data regarding "their medical symptoms and medical treatments, sleeping, eating, alcohol and drug use and exercising habits, body weight, blood glucose levels, pulse, moods, and stress levels and reproductive and sexual functioning and activities" is collected in order to improve their life in some way (Lupton, 2017, p.1). This data collection can be as simple as using an article of clothing to monitor changes and maintenance of body size and weight or using a thermometer to measure body temperature to track when conception may be more likely

to be successful within a menstrual cycle. In recent years, this self-monitoring has been expanded into hundreds of thousands of smartphone apps and gadgets that include wearable fitness trackers, such as Fitbits, and smartwatches, like the Apple Watch (Lupton, 2017). Pregnancy gives rise to a state of being that involves high levels of vigilance and risk-avoidance, and apps have become a way for a pregnant woman to alleviate these stressors and concerns while taking responsibility for their wellbeing and that of their unborn baby (Lupton, 2017). This concept can extend to a pregnant woman's decision to use a handheld fetal Doppler. This 'intimate surveillance' is a way of establishing and maintaining social relationships, as well as fostering feelings of closeness with significant others via shared knowledge (Lupton, 2017, p.9). It is also a method of feeling in greater control over an experience when it feels chaotic or challenging (Lupton, 2017). Women in this study enacted this intimate surveillance of their unborn babies using the handheld fetal Doppler to gain information about viability – the presence of a fetal heartbeat. The aim is to give themselves peace of mind when anxiety about miscarriage challenges their sense of wellbeing in their pregnancy and self. These challenges arose when women felt their pregnancy symptoms, such as nausea, bloating, and breast tenderness disappeared. These challenges were also apparent when certain gestational milestones were reached. For example, the same gestation in a previous pregnancy had been the time of a shock diagnosis of miscarriage during ultrasound scans at 12 weeks gestation or fetal death in the third trimester without the perception that fetal movement patterns had changed or reduced prior. The need to check in with the unborn baby at these milestones meant that the women could feel what they felt was a typical response that other women would have – joy at seeing their unborn baby in real-time on-screen, and trust in their own body.

### 5.5 Online Peer Communities

The ways people connect with their loved ones and their social peers have changed with the rise of the internet, smartphones, and social media. For pregnant women, connection with other pregnant women is mediated by online sources such as social media sites like Facebook, content sharing platforms like YouTube, and blogs and discussion boards aimed at pregnant women from commercial entities with vested interests in products for pregnant women, infants, and mothers (Lupton, 2017). Pregnant women appreciate the emotional closeness of other women mediated by these online communities, and the helpfulness of this support, particularly when isolated by distance from their families and friends (Lupton, 2017). Regardless if they never meet in person or live outside of their local area, these communities are ways of gaining practical advice and support from other pregnant women and new mothers (Lupton, 2017). Women in this study mostly came

across the idea of using a handheld fetal Doppler from other women in online forums and social media groups for women trying to conceive via IVF, miscarriage support, and who share a similar due date. Their information sharing around the products available, how to use them, and sharing recordings of their unborn baby's heartbeat was the underpinning information they were able to access. This information sharing filled a perceived knowledge gap that they felt their midwives were not able to share with them due to the feeling of Doppler use being taboo outside of a health professional context.

#### 5.6 What does this mean for women, midwives, and other providers?

In this study, pregnant women identified that they used a handheld fetal Doppler primarily as a strategy to control their anxiety around the status of their pregnancy and unborn baby, particularly if they had experienced infertility, miscarriage, or stillbirth. This feedback method during a time when quickening has not yet occurred is a way of establishing maternal-fetal attachment when feelings of stress and anxiety around the possibility of miscarriage diminish perceived enjoyment that they feel they should be experiencing a normal response to pregnancy.

Within the New Zealand partnership model of maternity care, the principles of equity, reciprocity, informed choice, and shared decision making, and responsibility means that women should be the drivers of what they need in their pregnancies. They are the experts of their selves and realities. Midwives in New Zealand are obligated to honour this by sharing knowledge and creating an educating, safe space for women to meet their self-identified needs. This ability for pregnant women to enact personal agency and expect to have the underpinnings of knowledgeable and educated support from their chosen lead maternity carer is unique to New Zealand and enshrined within the model of care itself.

Therefore, if a pregnant woman identifies that a handheld fetal Doppler may support her wellbeing in pregnancy, then shouldn't their midwife assist them in gaining the skills and knowledge they require to undertake this endeavour in a guided manner? After all, this action is what the pregnant women in this study would like to see in the future – more extensive support for the use of handheld fetal Dopplers from health professionals.

What is unknown are the views of midwives, and what reservations or supportive views they may have around handheld fetal Doppler use by pregnant women. While the scope of this study purposely did not include this line of enquiry, it would be an automatic next step towards developing a framework to support women and midwives in decision making around handheld

fetal Doppler use. What should underpin the framework is the appropriate scenarios for use compared to what should prompt a pregnant woman to seek an urgent assessment from her midwife.

### 5.6.1 Appraisal of Study Methods

#### 5.6.1.1 *Study Strengths*

The strength of this qualitative study is that it explored the novel phenomenon of the use of handheld fetal Dopplers, a medical technology, from the first-hand experiences of pregnant women. This study's results were comparable to a similar qualitative study undertaken in the UK from a sociological lens and published after the data analysis of this study was completed.

#### 5.6.1.2 *Study Weaknesses*

The limitation of this study was that it was a small-scale study with constraints from the selection criteria for one geographical region of New Zealand.

### 5.7 Conclusion

This study provides a qualitative account of women who have chosen to use a handheld fetal Doppler during pregnancy. In this study, six women used a handheld fetal Doppler before quickening to establish ongoing fetal life during periods of heightened anxiety around the status of the pregnancy. Women in this study have expressed their belief that handheld fetal Dopplers should be available to any women who might choose to use them, but particularly for women who have previously experienced pregnancy loss and fertility struggles and maternity carers should be helping them understand how to use them. Currently, women are turning to peer-to-peer resources that may not be factual or evidence-based, to make their decision in the absence of professional exploration and study of the use of these devices by non-health professionals. The handheld fetal Doppler technology is already in use, and the drive towards self-monitoring aspects of health will continue to attract pregnant women to handheld fetal Dopplers. A framework for women and midwives to guide the use of handheld fetal Doppler use by pregnant women is urgently needed.

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## Appendix 1: Interview Schedule

1. Demographic Questions:
  - a. Age
  - b. Ethnicity
  - c. Relationship Status
  - d. Highest Level of Education
2. Can you tell me about your experience of using a fetal heart rate monitor during your pregnancy?
  - a. How did you get your fetal heart rate monitor?
  - b. When in your pregnancy did you use it and why?
  - c. How did you learn how to use it?
  - d. What advice did you get about using it? Was this advice useful?
  - e. How did you feel about using the fetal heart rate monitor?
3. Any other comments on your experience of using the fetal heart rate monitor?

## Appendix 2: Information Sheet

### ***Personal use of fetal heart rate monitors by pregnant women in Wellington, New Zealand***

#### **INFORMATION SHEET FOR PARTICIPANTS**

You are invited to take part in this research. Please read this information before deciding whether or not to take part. If you decide to participate, thank you. If you decide not to participate, thank you for considering this request.

#### **Who am I?**

My name is Lyndal Honeyman and I am a Masters student in Master of Health Research at Victoria University of Wellington. This research project is work towards my thesis.

#### **What is the aim of the project?**

This project aims to discover the experiences of women who have used a fetal heart rate monitor at home during their first pregnancy.

This research has been approved by the Victoria University of Wellington Human Ethics Committee application ID number 0000026360.

#### **How can you help?**

You have been invited to participate because you have identified that you used a fetal heart rate monitor at home during your pregnancy. If you agree to take part, I will interview you in your home. I will ask you questions about your experience of using a fetal heart rate monitor. The interview will take 30-45 minutes. I will audio record the interview with your permission and write it up later. You can choose to not answer any question or stop the interview at any time, without giving a reason. You can withdraw from the study by contacting me at any time before 1<sup>st</sup> May 2019. If you withdraw, the information you provided will be destroyed or returned to you. You may have a support person with you during the interview.

#### **Inclusion Criteria**

- Currently over 20 weeks pregnant or have birthed a baby (20 weeks of pregnancy or over), living or stillborn, in the last 12 months.
- Aged over 18 years of age.
- Able to speak and read in English.
- Living in the Greater Wellington Region (Wellington City, Hutt City, Upper Hutt, Porirua, Kapiti Coast, and Wairarapa).

#### **What will happen to the information you give?**

This research is confidential. This means that the researchers named below will be aware of your identity but the research data will be combined and your identity will not be revealed in any reports, presentations, or public documentation. Your identity will be hidden by using a pseudonym.

Only my supervisor and I will read the notes or transcript of the interview. The interview transcripts, summaries and any recordings will be kept securely and destroyed on 1<sup>st</sup> December, 2022.

### **What will the project produce?**

The information from my research will be used in master's dissertation, and academic publications and conferences relating to the master's dissertation. Data generated by this project will not be reused.

### **If you accept this invitation, what are your rights as a research participant?**

You do not have to accept this invitation if you don't want to. If you do decide to participate, you have the right to:

- choose not to answer any question;
- ask for the recorder to be turned off at any time during the interview;
- withdraw from the study before 1<sup>st</sup> December, 2019;
- ask any questions about the study at any time;
- receive a copy of your interview transcript;
- be able to read any reports of this research by emailing the researcher to request a copy.

### **If you have any questions or problems, who can you contact?**

In the first instance, if you have any concerns during this study please contact your midwife or obstetrician.

If you experience any distress in participating in this study, please contact:

- Your GP
- Your Midwife or Obstetrician
- Healthline – 0800 611 116
- Lifeline – 0800 543 354 (0800 LIFELINE) or free text 4357 (HELP)
- Skylight (Grief and Loss Counselling) – 0800 299 100 or <https://skylight.org.nz>

If you have any questions, either now or in the future, please feel free to contact either:

#### **Student:**

Name: Lyndal Honeyman



#### **Supervisor:**

Name: Dr Robyn Maude

Role: Senior Lecturer

School: Graduate School of Nursing,  
Midwifery, and Health

Phone: [REDACTED]

[REDACTED]

**Human Ethics Committee information**

If you have any concerns about the ethical conduct of the research you may contact the Victoria University HEC Convenor: Dr Judith Loveridge, email: [REDACTED],  
phone [REDACTED].

## Appendix 3: Consent Form

### **Personal use of fetal heart rate monitors by pregnant women in Wellington, New Zealand**

#### **CONSENT TO INTERVIEW**

This consent form will be held for 5 years.

Researcher: Lyndal Honeyman, Graduate School of Nursing, Midwifery, and Health, Victoria University of Wellington.

- I have read the Information Sheet and the project has been explained to me. My questions have been answered to my satisfaction. I understand that I can ask further questions at any time.
- I agree to take part in an audio recorded interview.

I understand that:

- I may withdraw from this study at any point before 1st December, 2019, and any information that I have provided will be returned to me or destroyed.
- The identifiable information I have provided will be destroyed on 1<sup>st</sup> December, 2022.
- Any information I provide will be kept confidential to the researcher and the supervisor.
- I understand that the results will be used for a Masters dissertation and academic publications and presented to conferences.
- My name will not be used in reports, nor will any information that would identify me.  
Yes ☐ No ☐
- I would like a copy of the transcript of my interview  
Yes ☐ No ☐
- I would like to receive a copy of the final report and have added my email address below. Yes ☐ No ☐

Signature of participant: \_\_\_\_\_

Name of participant: \_\_\_\_\_

Date: \_\_\_\_\_

Contact details: \_\_\_\_\_



## Appendix 4: Ethics Approval

Human ethics application approval 0000026360. Automated Email, Do Not Reply

Tue 13/08/2019 1:22 PM

To:

[REDACTED]

Cc:

[REDACTED]

Dear ,

Thank you for your application for ethical approval (Personal use of fetal heart rate monitors by pregnant women in Wellington, New Zealand., reference 0000026360), which has now been considered by the Standing Committee of the Human Ethics Committee.

Your application is approved as of today. Your approval applies for three years from the date of this email.

If you would like to receive a formal letter please contact the HEC Administrator ([REDACTED]).

Best wishes with the research.

Judith Loveridge, Convenor  
Human Ethics Committee

\*\*\*\*\*This is an automated email. Do not reply to this email address\*\*\*\*\*

Queries for the central Human Ethics Committee can be sent to [REDACTED]