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Listening to Women: Using a Mixed-Methods Approach to Understanding Women’s Desires and Experience During Childbirth

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Listening to Women: Using a Mixed-Methods Approach to Understanding Women’s Desires and Experience During Childbirth

by

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy
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DEDICATION

In loving memory of my Mother, Linda, a free spirit. When I struggled, she would tell me that we were pebbles in a stream. That sometimes we’d get caught in a little whirlpool and we would stay awhile. Eventually, the current would carry us on, so don’t fight the current, she’d say, let it take you where you belong.
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My dearest friends, Sara, Leslie, Janet, Etel, and Kimberly, thank you for your friendship. We have seen each other through a lot and I couldn’t have made it through without you.

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ABSTRACT

This dissertation is based on evolutionary medicine and applied anthropological research where the narratives and biology of modern women are used to inform evolutionary theory, specifically obligate midwifery, and modern birth practices. Improvements to the US maternity care systems are needed as rates of maternal mortality and morbidity are continually higher than rates in other technologically advanced nations. Additionally, women birthing under the technocratic model of care, as is predominant in the US, report trauma and post-traumatic stress disorders due to their birthing experience, and more women are experiencing postpartum depression. Thus, I seek to use an evolutionary medicine perspective to inform modern birthways and specifically how to realize physiological normal birth in more instances.

I conducted research that unfolded incrementally in a three phased approach. In study section A, 226 participants responded to an online survey. These responses were used to establish six themes regarding ‘what women want’ in their birth experience and ultimately what environment is conducive to physiologic normal birth.

In study section B, four women collected five saliva samples each using dental swabs during their peripartum period, from early labor through 12 hours postpartum. These saliva samples were used to establish, first, that saliva collection for cortisol research among homebirth mothers is a viable research method, and second, to document for the first time known to me, the cortisol profile of homebirth mothers who experience a physiological normal birth.
Study Section C expanded on the knowledge gained from sections A and B. In this section, six women were recruited and four completed all segments of the study section, which included saliva samples, face-to-face interviews, and standardized questionnaires. The saliva sample protocol included the same five saliva samples collect in section B, but also expanded the protocol by requesting 16 additional saliva samples in the prenatal period to establish a cortisol baseline before labor initiated.

I found that when listening to women, their desires for birth can be described using six themes: 1) Be Respected; 2) Find Empowerment; 3) Create Atmosphere; 4) Have Autonomy; 5) Follow Instincts; and 6) Keep Baby Close. I found that when women described what they wanted and what environment was conducive to a physiological normal birth, their narratives included the presence of a knowledgeable and caring assistant. Through use of the standardized questionnaires, I found that women who were seen prenatally by a homebirth midwife had low levels of anxiety and low levels of fear of childbirth. And lastly, through analysis of the cortisol levels of eight physiologically normal homebirths, I found that cortisol levels begin to rise as early as when the mother perceives she is in early labor and spike at the moment of birth, perhaps higher than in any other human experience.

Thus, I conclude that birth is a time of great emotional vulnerability due, in part, to the extreme rise in cortisol levels and that a knowledgeable and caring assistant can mitigate that vulnerability by attending to the mother perinatally and perinatally. These findings lend weight to the obligate midwifery hypothesis in that assistance at birth is part of our evolutionary biological history and assistance at birth is conducive to physiological normal birth when the birth attendant acknowledges the woman’s birth desires.
CHAPTER ONE: INTRODUCTION

Through this research, I seek to contribute to the discussion of how to improve childbirth outcomes by using an evolutionary medicine perspective. I strived to document women’s voices regarding their childbirth experiences in the United States in the twenty-first century; as well as to document, for the first time known to me, women’s hormonal stress response to birth when birthing at home, a setting that is most typical of where our species delivered babies during most of human evolution, but is rare in modern America. I am conducting this research through the lens of humans as an evolved species, among which the mode of childbirth is evolutionarily and culturally shaped. Additionally, the bodies of childbearers are impacted by nutrition, trauma, disease, physical activity, and inheritance. And finally, childbirth is a psychological event as much as a physical event, wherein the mind, body, and soul cannot be disconnected.

Research on childbirth is critical for the health and wellbeing of women and thus society as a whole. Indeed, “maternal mortality is considered to be one of the main markers of the health of a nation and a bellwether indicator by which both human rights and public health can be evaluated” (American Public Health Association (APHA) 2011). Thus, maternal care has implications that reach far beyond the scope of pregnancy, labor, and delivery. Improvement upon our maternity care systems is needed in the United States, which ranks 46th in maternal mortality according to the WHO (World Health Organization 2015). Further, improving the US model of care is essential, as this model is exported to regions worldwide. As we progress further into the twenty-first century, maternal care systems must be evaluated and improved. Concerning
woman, how she is treated, how she experiences her birth have consequences for how she
experiences her body, her sexuality, her child, her family...birth is an event...All of that is
missing in the American ‘managed’ birth.”

One out of every five hospitalizations among females is related to pregnancy and
childbirth in the United States (Wier et al. 2010). As I write this introduction, I know women are
seeking alternatives to hospital births and that they experience fear and anxiety regarding
hospital stays (Gross and Morales 2020). Starting in the late 1990s, Armelagos and colleagues
discussed the third epidemiology transition as the reemergence of infectious diseases as a major
cause of human mortality (Armelagos, Barnes, and Lin 1996; Farmer 1996; Harper and
Armelagos 2010; Herring and Swedlund 2010). The novel coronavirus, Covid-19, has swept
through the United States and the world. Covid-19 is expected to be the third leading cause of
death in the US in 2020 (Woolf, Chapman, and Lee 2020). Thus, it is a crucial time for future
and current expectant mothers to question where and with whom they give birth; as well as it is a
crucial time for federal and state agencies, maternity care systems, and all organizations and
associations concerned with maternal and infant health to evaluate how to best serve mothers and
babies (see Profit et al., 2020).

Based on the latest available data, only 1.6% of births took place out-of-hospital in the
US in 2017, and when looking at non-Euro-American women, the rates are dramatically lower
(MacDorman and Declercq 2019). Research shows that birth at home, among low-risk
pregnancies, is just as safe for mother and baby as a hospital birth (Cheyney et al. 2014; Hutton
et al. 2019). Of course, some births require medical attention. Indeed, the WHO estimates that
approximately 10% of births require a cesarean section for safe delivery (Betran et al. 2016).
This analysis focuses primarily on those who identify as “white” or Euro-American women because they make up the majority of people who currently give birth at home. Although I am going to be using terms frequently used in Public Health to categorize participants in groups such as “White,” “Hispanic,” etc., this is done with the understanding that human genetic diversity is shared (Batai, Hooker, and Kittles 2020) and that these labels refer to cultural constructions. I recognize that childbirth outcomes among non-Euro-American women is in great need of research and improvement. For example, African American women are three times more likely to die from a pregnancy-related event or condition than white women in the US (Petersen et al. 2019). I acknowledge that childbirth outcomes and the treatment of minority women is a historically rooted issue embedded in racism, prejudice, and structural violence, and that the bodies of minority women, particularly those of enslaved women, were experimented upon for gynecological and obstetrical research that has led to modern-day obstetrics (see Owens, 2017). Additionally, the title of this dissertation is “Listening to Women,” and I want to stress that by listening I mean listening to women’s words as well as to women’s bodies. Further, I want to stress that I intend for the word women be inclusive of all childbearing humans. The research participants discussed here identified as primarily Euro-American or White, and married or coupled women. It is my hope and my prayer that research that seeks to better understand and address the needs of all those who bear children will be prioritized.

Trevathan (1997) describes the maternal body as an “evolved body,” and she reasons that to “understand more fully human be-ing, we must be aware that we are, as individuals, products of evolution, history, culture, society, biosocial development, and learning.” I want to stress this poignant statement as the backbone to the theory behind this research. To fully understand birth and know how to improve upon birth outcomes and experiences, we must view it through this
holistic perspective. I deploy this holistic perspective throughout this document by looking first at the evolution of modern humans (see “Modern Human Childbirth through an Evolutionary Lens” below). Secondly, I look at the ‘evolution’ of modern birthing practices in the US and birth practices cross-culturally. I consider the transfer of authoritative knowledge from mother to midwife and midwife to obstetrician and the dominance of the technocratic, humanistic, and holistic models of care (see “Birthing Systems” below).

Due to the mechanisms of human birth, Trevathan (1987, 2011) hypothesized that humans evolved, through natural selection, to a state of obligatory midwifery. I discuss this proposal in the literature review section “Secondary altriciality, a single birth mechanism, and obligate midwifery.” Obligate midwifery (or support during childbirth) has important modern implications for how women give birth today as well as for our understanding of how our species evolved. Through this present research, I seek to use a biocultural approach to address the questions below. The following four questions are intrinsically linked because previous research has shown cortisol increasing when individuals feel that they are not in control, and secondly, it has been suggested that when cortisol is too elevated, labor may stall. Stalled labor can cause a cascade of childbirth complications (Benfield et al. 2014; Buckley 2015; Burns 1975).

1) How do non-nulliparous homebirth mothers describe, qualitatively in an open-ended format, their desired birth experiences?

2) Does this qualitative data lend evidence for or against the obligate midwifery hypothesis?

3) Can perinatal maternal cortisol be successfully measured in homebirths, a setting that is most typical of where our species delivered babies during most of human evolution?
4) How does the perinatal maternal cortisol profile during home births, as measured in saliva via oral swabs, compare to the cortisol profile of previous studies conducted in-hospital?

The literature available on maternal cortisol levels during parturition is limited to biological samples taken in a clinical setting. Therefore, maternal cortisol levels and maternal cortisol reactivity compared to a baseline measure is virtually unknown during parturition out-of-hospital (see “Physiology of Childbirth” below). There are data available that indicate that maternal stress, including fear and anxiety, during labor and delivery is altered by who attends the birth and the place of birth (Christiaens, Van De Velde, and Bracke 2011; Christiaens, Verhaeghe, and Bracke 2010; Jordan 1978; Levy, Wilkinson, and Marine 1971; Sosa et al. 1980; Trevathan 1987) (see “Birthing Systems” below).

In the following pages, I will present the literature review (Chapter 2), material and methods (Chapters 3), results (Chapter 4), and conclusions (Chapter 5). The original research conducted for this project incorporated four data collection methods: 2 qualitative and 2 quantitative. The results consist of written narratives, oral narratives, standardized questionnaires, and saliva samples.

The online survey produced a set of written narratives. While 226 participants responded to the survey, 102 responses met selection criteria and were coded for analysis. The face-to-face-interviews produced recorded oral histories. Six women participated in the interviews. The standardized questionnaires measured anxiety and fear of childbirth that is comparable to other studies. Six women participated in the questionnaires (these are the same six women who participated in the interviews). The biological samples allowed for the measurement of maternal salivary cortisol in the prenatal and perinatal periods. Eight women were able to collect a
complete set of saliva samples for the analysis of cortisol. A total of 112 saliva samples were collected (four of these women also participated in the interviews and questionnaires) (see Figure one for a chart of the study design).

This research aims to bring a better understanding to physiologic normal birth by touching on two points. First, what environment is conducive to physiological normal birth? Second, what is the hormonal biology of physiological normal birth, specifically cortisol? Future research could incorporate more hormone markers, such as oxytocin, epinephrine and norepinephrine and prolactin. See Buckley (2015) for an indepth description of each and the relation to childbirth.
CHAPTER TWO: LITERATURE REVIEW

In the following review, I will first describe the modern synthesis of the theory of evolution as the subsequent descriptions are dependent on evolutionary and adaptive actions. I describe the Obstetrical Dilemma and the three proposed ‘solutions’ or evolutionary adapted traits to the Dilemma as well as proposed alternatives to the Obstetrical Dilemma. Following, I describe the birth mechanism (how the fetus passes through the maternal pelvis) of modern human birth as it would occur without medical intervention. I then compare how this differs from extant non-human primates (modern monkeys and apes) and extinct hominins (Ardipithecus, Australopithecus, and extinct Homo species). Then, I discuss what implications the morphology of the human pelvis, and thus the mechanism of human birth, has on human culture, specifically obligate midwifery (Trevathan 1987, 2011), and how a culture of cooperative breeding influences human biology (Bogin 2006).

Modern Human Childbirth Through an Evolutionary Lens

Modern human birth is a product of our evolutionary heritage which shaped our pelvis for upright long distance walking called bipedalism, which started evolving around five million years ago based on the fossil record uncovered to date. According to the modern synthesis of the theory of evolution, there are four forces of evolution: mutation, gene flow, genetic drift, and natural selection. Mutations introduce genetic variation at the individual level and are random events. Natural selection can work on mutations to eliminate them from the gene pool or increase
the mutations in the gene pool. Genetic variation is eroded by genetic drift. Gene flow introduces new genetic variation into a population from another population (Futuyma 2010). The extended synthesis adds additional elements to the modern synthesis (Pigliucci and Finkelman 2014). As one example of a new element not previously considered under the modern synthesis, epigenetic inheritance is now understood to allow for acquired characteristics of the parent to be passed down to the child. Put another way, the offspring’s phenotype (displayed characteristics) is influenced by the ancestral lived experience. For example, ancestral diet and lifestyle, before and after conception, affect offspring health (Gabbianelli et al. 2020; Guo, Luo, and Lin 2020).

While inheritance based on lived experience is reminiscent of Lamarckian inheritance, epigenetic inheritance is not at odds with the modern synthesis. As our understanding of evolutionary biology continues to expand, our paradigm should be flexible enough to absorb the new data such as that considered under the extended synthesis including epigenetic inheritance and other new phenomena (Pigliucci and Finkelman 2014).

*Comparative Pelvic Morphology of Extant and Extinct Primate Species*

The size and shape of the human pelvis is unique among primates. Here, I describe the features and shape of the human pelvis and the rotations the human fetus must make to traverse the birth canal. Next, I compare the human female pelvis and birthing mechanism to those of extant non-human primates, and compare the modern human pelvis to those of extinct hominin pelves. Further, I discuss the selective forces that likely contributed to the evolution of the human pelvis.
Morphology of the Modern Human Pelvis

The pelvis can be divided into two parts, the true pelvis and the false pelvis. The false pelvis is anatomically situated anterior-superior to the true pelvis and is made up largely by the ilia. The false and true pelves are separated by the linea terminalis. The true pelvis forms the birth canal and is the area of obstetrical importance. The true pelvis can be divided into three planes; the inlet, midplane (or cavity), and outlet. The inlet (or pelvis brim) begins with the upper border of the pubic symphysis anteriorly and sacral promontory posteriorly. The pelvic cavity is surrounded by bone. The pubic bone forms the anterior section of the cavity, the pelvic surface of the ischium and part of the ilium form the lateral sides, and the sacrum and coccyx form the posterior section of the pelvic cavity. The pelvic outlet concludes with the lower margin of the pubic symphysis, ischial tuberosity, and the tip of the coccyx (Figure 1) (Halim 2009; Rosenberg 1992).

Figure 1: Modern human pelvis (A) and modern chimpanzee pelvis (B)
The three planes of the birth canal are notable not only for the features that define them but also because each plane has a distinct size and shape from the others, which has considerable obstetrical significance. The pelvic inlet has the largest circumference of the three planes and is transversely elongated. The midplane is anterior-posteriorly elongated and has the smallest circumference. The outlet is approximately circular (Rosenberg 1992) or is widest in the anterior-posterior position and the outlet opens in front of the ischial tuberosity (Trevathan, 1988).

The size and shape of the human birth canal relative to the fetal head and shoulders requires the fetus to rotate during descent. First, the long axis of the fetal head must align with the long axis of the maternal pelvis. If the human birth canal was spacious this may not be a concern. However, the fetal head is typically longer anterior-posteriorly than the maternal inlet in the same direction, thus the anterior-posterior axis of the fetal head must orient along the transverse or oblique diameter of the maternal pelvis. In other words, the fetus faces the lateral side of the maternal body upon descent into the pelvic inlet. The shoulders remain in a transverse position until the head emerges and the neck is twisted 45 to 90 degrees during descent (Trevathan, 1988; Rosenberg, 1992).

Following descent through the pelvic inlet, internal rotation of the fetal head occurs. As described above, the midplane is the smallest and the longest midplane diameter lies along the anterior-posterior axis (in contrast to the inlet). Typically the fetus is faced dorsally (or towards the maternal sacrum). The maternal and fetal sagittal axes are now aligned. The fetal occipital bone is in contact with the maternal pubic symphysis while the head is flexed pressing the chin to the chest and allowing the smallest cranial dimension to enter the maternal midpelvis/cavity. Because the outlet opens in front of the ischial tuberosities, the fetal head must bend back to
emerge, and thus transitions from a state of flexion to extension (Berge, Orban-Segebarth, and Schmid 1984; Trevathan 1988). When the fetal head emerges, external rotation of the head occurs realigning the fetal head and shoulders (restitution) as the shoulders descend through the anterior-posterior elongated midplane and the anterior shoulder can emerge under the pubic symphysis. Once the head and shoulders have emerged the fetal body can be delivered easily.

A few points are important here. First, the human fetal head and shoulders must rotate to traverse the birth canal and the fetal head must enter a state of flexion followed by extension. This mechanisms of human birth is critical to the theory of obligate midwifery, which is described further below. Second, passage of the shoulders is just as important as passage of the head in humans due to broad and rigid shoulders that may become stuck (shoulder dystocia) (Trevathan 1988; Trevathan and Rosenberg 2000). Finally, the description above is of what is most typical of human birth; however, the fetal body may present in varying positions which can increase the likeliness of maternal or fetal injury or death as well as maternal pain. However, not all alternative presentations are pathological. Goodarzi describes her experience attending a first-time mother in-hospital in the Netherlands. The mother was hoping for a vaginal delivery, and baby was doing fine based on the electronic fetal monitor; however, the baby’s hand was presenting instead of the head as described above. The mother was fully dilated and pushing reflexively. Goodarzi positioned the mother on a birthing stool where her vertical position would allow her pelvis to widen and gravity would help the baby descend. The baby was born fingers, hand, and arm first with no complications otherwise (Cheyney et al. 2019).

To articulate how the mechanisms of modern human birth have evolved, I will now describe the pelves and mechanisms of birth among extant non-human primates and extinct
hominins. I stress this comparison because I wish to convey that modern human birth, with the twists and turns, is a product of evolutionary adaptation.

A Comparison to Extant Primates

The human mechanism of birth is unique and quite different from that of our closest living relatives. Schultz (1949) demonstrated, in a now well published illustration, the average fetal head length, head breadth, and shoulder breath in comparison to the average maternal pelvic inlet among eight species. Schultz demonstrated that while the fetal measurements were relatively small compared to the maternal measurements in orangutans, chimpanzees, and gorillas, the human fetal measurements reached beyond the maternal measurements. Likewise, Leutenegger (1982) demonstrated that the pelvic inlets of the great apes are relatively spacious, while the pelvic inlets of monkeys, lesser apes, and humans are relatively unspacious. For example, in Leutenegger’s sample, the gorilla fetal head breadth occupied 64% of the maternal pelvic inlet. In comparison, the human fetal length occupied 102% of the maternal pelvic inlet. Such a ratio requires dilation of pelvic ligaments and often temporary deformation of the infant skull (Rosenberg 1992). Indeed, the human fetal cranium is plastic or malleable because the metopic sutures are not yet fused (Falk et al. 2012; Kawada et al. 2020). Contrary to human infants, sutures in monkeys are completely fused at birth and, while the fontanelles are still present in apes at birth, they are smaller than in humans (Schultz 1969).

Monkeys and gibbons display constricted birth canals. Indeed, the squirrel monkey (Saimiri sciureus) is estimated to have a relative cranial breadth of 121% (Leutenegger 1982). Although the relative cranial breadth of many monkeys may be similar to that of humans, the mechanism of birth is different due to the shape of the true pelvis. In monkeys, the longest
diameter of the fetal head and maternal inlet are in the same direction and the longest diameter does not change directions midplane as in humans. Thus, the fetal head does not require rotation. Further, in most non-human primates the fetus emerges behind the ischial tuberosities and does not need to bend as is required in humans. Fetal head is usually extended throughout. Cephalopelvic disproportion, when the fetal head is too large to pass through the maternal birth canal, has been documented in monkeys and humans, and it is a known cause of infant and maternal mortality in both (Rosenberg and Trevathan 1995).

Human birth is different from that of other extant primates in the directionality of the fetal face. In non-human primates the typical way an infant emerges is occiput posterior (popularly known as ‘sunny side up’). In this position the mother and infant are face to face; the mother can guide the infant to the breast and wipe away any mucus and fetal membrane from the face. In human birth on the other hand, the infant usually emerges occiput anterior, thus the back of the head faces the mother. Because she may injure the infant’s neck, possibly causing paralysis, a human mother may not have the capacity to guide her infant out of her birth canal or supply immediate care, such as detangling the umbilical cord. Thus, while the occiput anterior fetal position is best for the progression of labor in humans, it is not conducive to the birth mother attending to her new born after the head is born and before the body is born as is seen in other extant primates (Trevathan, 1988).

The occiput anterior position has been reported in non-human primates (Hirata et al. 2011; Trevathan 1988). However, the occiput anterior position in non-human primates is regarded as the exception, while in humans this position is the standard. Conversely, humans also experience occiput posterior positioning known as “persistent posterior” (also known commonly as ‘back labor’), but it is the exception (Trevathan, 1988). Hirata et al. (2011:1) argue
that, “[T]he above notion about human uniqueness, [occiput anterior positioning], is not entirely confirmed because there are few comparative data on birth in non-human primates”. Hirata et al. (2011) observed and recorded the birth of three captive chimpanzees (Pan troglodytes) at the Great Ape Research Institute of Hayashibara Biochemical Laboratories, Inc. The authors found that fetal emergence varied but was not occiput posterior. In all three cases, the head emerged occiput anterior. In two cases where the infant continued in an occiput anterior position, the mother allowed the infant to fall to the floor before she picked the infant up. The mother did not assist manually in the birth. In one case, the infant rotated to an occiput posterior position with the emergence of the shoulders, and the mother did reach down to lift the infant to her. Hirata et al. (2011:3) argue that their “observations contradict the traditional view that the occiput anterior position and head rotation are unique to human birth...[and that] the mechanism of birth in great apes is not affected by the relationship between the size of the foetal head and body and the size of the maternal birth canal.” Indeed, the authors acknowledge that the fetal head length is largest in the anterior-posterior dimension in both humans and great apes and that both have broad and rigid shoulders. Therefore, Hirata et al. (2011) argue that the birth pattern they observed can be explained by the chimpanzee fetal head and shoulders aligning with the sagittal (long axis) of the maternal pelvis. Thus, “the mechanism of birth in chimpanzees is affected by the relationship between the size of the foetal head and body and the size of the maternal birth canal” (Hirata et al., 2011:3). This view is contrary to that of Tague and Lovejoy (1986), Trevathan (1988), and Rosenberg (1992).

The repertoire that makes up the human mechanism for birth is derived due to bipedalism and the twisting of the pelvis, encephalization and a tight birth canal (both of which require the fetal head to internally rotate), broad and rigid shoulders (which require the fetal head to
externally rotate), and occiput anterior positioning of the fetal head upon emergence making maternal care of the infant not likely before the entire body has emerged.

A Comparison to Extinct Hominins

Through the examination of the fossil record, questions addressing the evolution of the human birth process and pelvic morphology can be addressed. For example, when and due to what selective forces did humans evolve the unique process of birth? Are the human fetal emergence patterns derived characteristics of all hominins (Berge et al. 1984), of the more recent *Homo* genus (see Tague and Lovejoy, 1986), or even more recently with Neanderthals (Gibbons 2008)?

Trevathan (1996) suggests that the evolution of the human pelvis took place in a mosaic fashion. Constraints the pelvis and birth canal would have adapted to are bipedalism, encephalization, and broad and rigid shoulders. The birth mechanism of extinct species must be inferred, it is widely accepted that the birth process can be determined based on pelvic morphology (Tague and Lovejoy, 1986; Rosenberg, 1992).

Lovejoy et al. (2009) reconstructed and analyzed the pelvic remains of the Aramis *Ardipithecus ramidus* partial skeleton (ARA-VP- 6/500), a 4.4 Myr hominin female. He concluded that *Ar. Ramidus* walked upright in an effective manner due to adaptations in the upper pelvis while the lower pelvis remained ape-like. Thus, the *Ar. Ramidus* pelvis was a mosaic. Data suggests that the primitive condition for African hominins would be to have a low infant: mother mass ratio (IMMRs). *Ardipithecus* would have had babies at 2.1% to 3.2% of the mother’s body mass, which is within the range of modern African apes. In comparison,
Australopithecus is estimated to have had a IMMR of 4.9% to 6.7% and modern humans 4.8% to 6.5%, or approximately a 6-7 lbs baby for a 110 lbs women (DeSilva 2011).

Berge et al. (1984) argued that the pattern of human birth is a consequence of bipedalism, and thus, is characteristic of both australopithecine and Homo births. Conversely, Tague and Lovejoy (1986) argue that because the shape of the australopithecine is extremely platypelloid shaped, the fetal head would have descended in the transverse position and would not have rotated as the broadest diameter would have been transverse at both the inlet and outlet (unlike humans).

Lovejoy et al. (2009: 71) states, “One of the oldest hominid pelves, that of Australopithecus afarensis (A.L. 288-1; “Lucy”), shows that her species had already evolved virtually all of the fundamental adaptations to bipedality” living approximately 3.2 million years ago. While the A. afarensis pelvis was adapted to bipedalism, Lovejoy et al. (2009) propose the changes seen in the Homo pelvis resulted from constraints of encephalization; this point stresses the mosaic nature of the evolution of the human pelvis.

The more recent discovery of the specimens attributed to Homo naledi, living between 236,000 and 335,000 years ago, continues to display a mosaic of features. According to Berger et al. (2015, 2017), H. naledi displayed a flared pelvis and small brain size like that of Australopithecus; however, the cranial morphology, while unique, was most similar to Homo erectus and other early Homo species.

Contrary, to Tague and Lovejoy (1986), Trevathan (1988) argues that the broad and rigid shoulders, characteristic of all hominoids, would have to rotate during australopithecine birth after emergence of the head to avoid shoulder dystocia, or the failure of the shoulders to descend after the head has emerged. Alternatively, the fetal neck could have twisted allowing the
shoulders to pass through the transversely elongated birth canal (Trevathan 1988). “Shoulder size may well have been among the causes of selection for the more rounded pelvis of later hominids” (Trevathan 1988:677).

Many questions still remain regarding when and how the evolution of the mechanism of human birth evolved (Nowell and Kurki 2020). Is the occiput anterior position unique to humans as discussed by Trevathan (1987), or do non-human primates also experience this position as described by Hirata et al. (2011)? Did australopithecine fetuses descend straight down the birth canal with no rotation (Tauge and Lovejoy 1986), or did the fetal head and shoulders rotate after emergence of the head to allow the shoulders to descend (Trevathan, 1988)? Is a tight birth canal (or high relative cranial breadth/length) the primitive state for the last common ancestor to hominoids (Leutenegger, 1982), and is a low infant:mother mass ratio (IMMR) the primitive condition for the African hominids (DeSilva, 2011)?

Based on the fossil record, the modern human pelvis evolved in a mosaic fashion with the evolution of bipedalism starting around five million years ago. It could be around this time that hominin females began to seek assistance during labor and delivery. Non-hominin primates typically seek isolation during birth. And indeed, there are accounts of female monkeys and apes stopping labor contractions when they are being observed. In a personal account told to me, a woman was in labor in her home, her husband was away and only her and her 4 year old daughter were home. She labored for most of the day. When contractions became heavy she called the midwife to come over to assist in the birth. She had been progressing in labor all day, but when the midwife arrived, her labor ceased. In an hour or so after the midwives arrival, the woman’s labor began again and she delivered the baby at home with the midwife and her daughter present. I use these anecdotes to suggest that the environment of birth is critical to our
non-hominin relatives just as it is to modern humans; however a shift may have occurred up to five million years ago wherein that optimal environment for birth included companionship.

The Obstetrical Dilemma

The obstetrical dilemma, as coined by Washburn (1960), describes what is commonly believed to be a disjunction between bipedalism with encephalization and the ability of human women to give birth safely. Washburn argued that the human pelvis evolved for bipedal locomotion at the same time as a larger brain size evolved for tool use. Thus, the human pelvis became shorter and the birth canal compressed compared to the long pelvis of the quadruped apes leading to the human infant being born developmentally earlier, according to Washburn. While Washburn did not implicate the obstetrical dilemma in difficult childbirth, Krogman (1951) called human birth the ‘scar’ of human evolutionary history. Since then, the obstetrical dilemma, that is the narrowing of the maternal pelvis with bipedalism and the increase in fetal brain size with encephalization, has been implicated in the difficult passage of the large fetal head through the narrow and twisted birth canal (Trevathan, 1987; Rosenberg, 1992; Rosenberg and Trevathan, 1996).

Secondary Altriciality, a Single Birth Mechanism, and Obligate Midwifery

Three hypotheses have been put forth regarding biocultural responses to the obstetrical dilemma - secondary altriciality (Montagu 1961), a single human birth mechanism (Berge et al. 1984), and obligate midwifery (Trevathan, 1987). The secondary altriciality hypothesis describes the relative immaturity of human newborns compared to that of other primates and proposes that
this relative immaturity evolved with the genus Homo in response to encephalization (an increase in brain mass compared to body mass). The singular human birth mechanism hypothesis posits that there is one trajectory for normal human birth and that the fetus makes a specific set of twists and turns to exit the birth canal in the occipital anterior position (facing away from the mother). According to the obligate midwifery hypothesis, the mechanism of human birth, particularly occiput anterior positioning, led to a new phenomenon (or derived characteristic), namely assisted childbirth. Trevathan (1987) argues that the behavior of seeking companionship at birth would have been selected for by natural selection due to a reduction in mortality in assisted births. She argues that this behavior is at least two million years old and associated with the encephalization in the genus Homo. Trevathan acknowledges that Homo females could give birth unassisted, but that assistance would decrease mortality. Trevathan (1988:679) states, “Today [assisted birth] is almost universally distributed in our species,” and thus “human birth is a social, rather than a solitary event” (Rosenberg and Trevathan 1995:164).

Alternatives to the Obstetrical Dilemma

The obstetrical dilemma including the secondary altriciality and obligate midwifery hypotheses have recently come under criticism on four different fronts (Dunsworth 2018; Dunsworth et al. 2012; Fischer and Mitteroecker 2015; Walrath 2006; Wells, DeSilva, and Stock 2012). Dunsworth et al. (2012) argue that while the obstetrical dilemma and secondary altriciality hypotheses claim that human gestation, fetal brain size, and fetal body size are reduced compared to other hominoids the reverse is actually true. Humans are born with brains around 30% their eventual adult size, and chimpanzees are born with brains 40% their adult size, which has been used to propose that humans are born more immature than chimpanzees (Desilva
and Lesnik 2006). However, Dunsworth et al. compared human gestational length and neonatal brain and body size to maternal body size. Dunsworth et al. concluded that humans have a relatively long gestational length, and large neonatal brains and bodies compared to our non-bipedal hominoid relatives, indicating that the evolution of a narrow human pelvis did not in fact truncate human fetal growth.

The obstetrical dilemma further states that the maternal pelvis was not broadened to accommodate large neonatal heads due to the evolutionary constraint to conserve locomotor efficiency as it was hypothesized that a broader pelvis would increase metabolic demands (Ruff 2017; Washburn 1960). Evidence against this hypothesis has been established and concluded that females do not have a reduced locomotor economy compared to males and that broader pelves are not less efficient (Dunsworth 2018; Warrener et al. 2015). Finally, Dunsworth et al. found that maternal pelvis dimensions would have to increase by only 3-cm to accommodate an increased neonatal brain size to 40% of adult brain size, which they argue should be achievable. Therefore, Dunsworth et al. argue that another mechanism besides maternal pelvis size is dictating the timing of human birth. Dunsworth et al. (2012:3-4) have proposed the EGG hypothesis (energetics of gestation and fetal growth) and argue that energetic constraints not maternal pelvic constraints determine when the baby is born. That is, the infant is born when the mother’s metabolic rate can no longer sustain the needs of the fetus or what is known as the “metabolic crossover hypothesis” (Ellison 2001). “Labor begins when fetal energy demands surpass, or “crossover,” the mother’s ability to meet those demands. The timing of parturition is determined by metabolic stress via hormonal signaling” (Dunsworth et al. 2012:15214). It is estimated that during gestation the mother’s metabolic rate reaches around 2 times her basal metabolic rate and this is the maximum sustained metabolic rate in humans; thus the infant must
be born to continue growth. They argue that this is true across mammals and is not different for
humans. Based on this new evidence, the question arises, why then is modern human childbirth
difficult and potentially dangerous?

In objection to the obstetrical dilemma and obligate midwifery hypotheses, Walrath
(2006: 63) argues that the human female body is designed to give birth safely and urges for
scientific research to turn its attention towards the “identification of biological mechanisms
accounting for successful childbirth in our species that do not rely upon culture.” Walrath (2006)
describes the history of evolutionary discourse as a means to naturalize social facts, particularly
Euro-American practices related to childbirth, which views the female body as distressed and
incapable of birthing and therefore reinforces the medicalization of birth. Walrath places the
three proposed solutions to the obstetrical dilemma in a medical paradigm. In response to
secondary altriciality, Walrath argues that human newborns are not as inert as described in the
hypothesis, but suggests that the typical neonate in a biomedical setting is heavily sedated due to
anesthesia. Indeed, human neonates are capable of independently maneuvering their way to the
mother’s breast and initiating sucking (Righard and Alade 1990). In response to the singular
human birth mechanism, Walrath again argues that this is a modern biomedical misconception.
In the past a variety of presentations were viewed as normal, but recent biomedical practices
have limited normal presentation to only include the occiput anterior position. Finally, in
response to the obligate midwifery hypothesis, Walrath argues that it too is embedded in a
modern biomedical paradigm embracing both the secondary altriciality and singular human birth
mechanism.

Walrath finds that genetic modifications on the X chromosome have allowed the female
body to grow adequately large to birth large-brain neonates successfully. Specifically, Walrath
found that the androgen hormone receptor located on the X chromosome modulates sexual dimorphism of body size. Looking at the genetic evidence in primate species, Walrath and Bingham (2003) found a significant correlation between the androgen receptor gene CAG repeat length and the degree of sexual dimorphism. Walrath (2006:67) writes, “Species with high amounts of dimorphism have a low number of CAG repeats, while species with less dimorphism have a repeat expansion…Humans have the highest normal range in terms of numbers of CAG repeats in this part of the androgen receptor gene.” Therefore, according to Walrath (2006: 67), humans have evolved minimal sexual dimorphism, which “could be particularly advantageous to females as an adaption to bearing large-brain young.”

Walrath (2006) concludes that morbidity and mortality associated with childbirth is not due to a species-wide obstetrical dilemma but due to socio-cultural factors including feminization of poverty and structural violence against women. She further argues that the view of the female body as flawed in turn produces an unfavorable situation for natural childbirth. Thus, Walrath (2006: 70) states, “Movement away from the gendered obstetrical dilemma, a cultural-bound notion of inadequate female biology requiring cultural interventions to perform a distinctly female biological task, will improve not only the quality of scientific investigation but also the lives of women.”

In agreement with Walrath, Wells et al. (2012) argue that, indeed, the morbidity and mortality associated with childbirth is not due to a species-wide obstetrical dilemma but the obstetrical dilemma may wax or wane over time and between populations due to ecological factors that influence the phenotypic plasticity in maternal height and pelvis size and neonatal head circumference and body mass,. Specifically, they state that ecological factors including thermal environment, dietary energy availability and glycemic load, and infectious disease
burden, influence the difficulty with which women give birth. Therefore, the ‘bipedalism-encephalization conflict’ hypothesis is either insufficient or overstated in the explanation of perinatal mortality. Wells et al. argue that the obstetrical dilemma is more severe among *Homo sapiens* but is not associated with Pleistocene *Homo*. They find that the emergence of agriculture caused an increase in the difficulty with which women give birth due to an increase in energy availability, glycemic load, and infectious diseases. These three factors increased neonatal body mass and shortened maternal height, two indicators of difficult childbirth. Further, in contemporary humans, increases in maternal BMI and gestational diabetes, which are influenced by maternal diet and activity level, affect the difficulty with which women give birth, which is then exacerbated by the supine birth position. Wells et al. conclude that with proper long-term public health measures that target nutrition, activity levels, and birth position, the severity of birth complications will be reduced. Thus, according to Wells et al., the obstetrical dilemma is not an evolutionary tug-of-war, but the result of ecological and sociocultural factors.

Fischer and Mitteroecker (2015) looked at pelvis shape, stature, and head size and concluded that pelvis shape was a covariate to stature and head size. They found that individuals with a smaller head as well as taller individuals had a more oval pelvic inlet while those with bigger heads and shorter stature had more round or ‘gynecoid’ pelvic inlets. Gynecoid pelves are presumed to allow for easier childbirth; therefore, they argue, there is “correlation selection” allowing for those with bigger heads or shorter stature to give birth more easily.

The obstetrical dilemma, obligate midwifery, and the alternative arguments to these hypothesis will be examined in my research by listening to women. Specifically, when prompted by the question “Please describe your birth experiences,” how do women describe a positive or
desired experience. This research will help to resolve the competing hypotheses by adding the parturients’ voices to the discussion.

*Evolution and Human Life History*

Bogin (2006) acknowledges that the knowledge we have regarding human growth and development is mostly derived from nonhuman animal research. This is possible because humans, as mammals, share many common features and growth processes with other mammals. While some features of growth and development may be the same, humans do have unique (derived) features, such as childhood, the adolescent growth spurt, and menopause. Bogin argues that these human specific life history traits allowed for greater reproductive advantages.

The life history strategy of each species determines, particularly for mammals, prenatal growth, duration of infancy (pre-weaning), timing until adulthood, and death. How well these strategies work in a particular environment determine the fertility and mortality of the individual or species (Bogin 2006). Bogin (2006) identifies four stages of human growth and development: infancy, childhood, juvenile, and adolescent, with a fifth stage, adulthood, in the human life history strategy. The infancy and juvenile stages are shared with other mammals, including non-human primates. The childhood and adolescent phases are unique to humans. Bogin states that life history traits are crucial for understanding major evolutionary changes, as changes in growth, development, and maturation proceed evolutionary change. Bogin argues that childhood and adolescence evolved as part of human life history due to the reproductive advantage they afforded.
Compared to other living hominoids such as chimpanzees, gorillas, and orangutans, humans have a relatively short infancy (defined as the period of breastfeeding). According to Bogin, human babies wean around the age of three years old, while chimpanzee infants wean just after five years. While weaning for humans is relatively early, humans are delayed in the eruption of their first permanent molar. For example, chimpanzee infants erupt the first molar about a year before weaning and gorillas and orangutans erupt the first molar contemporaneous with weaning. Human children on the other hand, erupt the first permanent molar three or more years after weaning. Continuing the trend for delayed maturation, humans are also delayed in age at menarche and age at first birth, compared to other great apes. Bogin discusses learning as an important feature of childhood, but sees the benefits of learning complex systems as secondary, evolutionarily, to increased fertility.

Mean age at first birth is relatively delayed for humans (age 19) compare to chimpanzees (age 14), gorillas (age 10), and orangutans (age 15). According to life history theory, the delay between menarche and first birth (adolescence) allows human females to acquire life skills before adulthood.

Bogin (2006) views culture as an influence on human life history traits, and claims the evolution of childhood is a direct attribute of biocultural adaptation. Specifically, human biocultural cooperative breeding allowed female hominins a reproductive advantage. Hominins achieved higher fertility and higher offspring survival through biocultural cooperative breeding. Bogin (2006: 198) writes, “The primary driver of the evolution of human life history was the evolution of childhood and cooperative care of children. These allowed for more rapid reproduction, higher quality offspring, and lower prereproductive mortality than ever before in mammalian history.” Bogin terms this behavior “cooperative breeding.” Bogin focuses on the
cooperative care of children and reduced age at weaning in the cooperative breeding profile. This human trait is hypothesized to have led to human childhood, a unique life history stage to humans. It seems reasonable to include assistance at birth as part of the cooperative breeding profile of humans. As described by Trevathan (1987), assistance at birth is hypothesized to have resulted in decreased mortality in those who practiced it, spurring the evolution of obligatory midwifery and possibly other cooperative behaviors.

**Epidemiology of Childbirth**

Research on childbirth processes, birthing systems, and birth outcomes is needed as maternal mortality continues to rise in the United States despite goals to reduce the maternal mortality ratio (MMR). The MMR is defined as the number of maternal deaths during a given time period per 100,000 live births during the same time period. According to the WHO (World Health Organization 2014), 12 women died due to childbearing complications for every 100,000 live births in the United States in 1990. The U.S. Department of Health and Human Services (HHS) Healthy People 2020 goal was to reduce the US maternal mortality ratio by 10% from 12.7 to 11.4 maternal deaths per 100,000 live births (HHS 2010). Similarly, the UNICEF Millennium Development Goal 5 was to reduce the MMR by three quarters between 1990 and 2015 (UNICEF, 2008). However, in 2010, the ratio in the US jumped to 21 maternal deaths, and in 2013, it jumped again to 28 maternal deaths per 100,000 live births. Now the Healthy People 2030 is to reducing the rate from 17.4 maternal deaths per 100,000 live births, which occurred in 2018, to 15.7 (HHS 2020).
The US MMR is extremely low compared to some nations. For example, Afghanistan, Angola, Burundi, Cambodia, Central African Republic, and Chad all are estimated to have over 1,200 maternal deaths per 100,000 live births in 1990, while Sierra Leone had an estimated MMR of 2,300 (World Health Organization 2014). In 2013, these rates have all drastically decreased with only Sierra Leone having an estimated MMR above 1,000.

Although the US has a relatively low ratio compared to the global MMR of 360 maternal deaths per 100,000 live births, it has poor outcomes when compared with other wealthy nations. Indeed, in 2013, the MMR for ‘Developed regions’ was 16 compared to the US at 28. Further, Finland, Sweden, Italy, Czech Republic, Iceland, Greece, and Poland all reported 5 or fewer maternal deaths per 100,000 live births in 2010 and 2013 (World Health Organization 2014). Thus, the US has four to six times the maternal death ratio compared to countries with the lowest rates.

The trend in severe maternal morbidity during delivery is likewise on the rise in the United States. In 1998-1999, the rate of maternal morbidity was around 75 per 10,000 deliveries. That number has steadily risen to around 160 in 2010-2011 and affects approximately 52,000 women in the US. Based on these trends, maternal morbidities are expected to continue to rise (Callaghan, Creanga, and Kuklina 2012). The higher rate of maternal morbidity and mortality in the US has been attributed to an over-medicalization of childbirth (Freeze 2008; Johanson, Newburn, and Macfarlane 2002). Thirty-three percent of all deliveries in the US are by Cesarean, and 23% of all births are induced (MacDorman, Mathews, and Declercq 2012). In vaginal deliveries, 61% of women in the US receive an epidural (Osterman and Martin 2011).
A century ago, almost all US births occurred in the home. In 1944, this proportion dropped to 44%. By 1969, only about 1% of births occurred in the home. In the last decade, the home birth rate has been on a slow but steady incline, climbing from 0.87% in 2004 to 1.26% and 1.36% in 2011 and 2012, respectively. The homebirth rate is highest among non-Hispanic Euro-American women at 2.05% while the rates of all other ethnic/racial categories hover around 0.5%. Home births had the following birth attendants: 62% of home births were attended by midwives, 28% of home births were attended by “other” attendant, and 5% of home births were attended by a physician (primarily due to “emergency situations”). For hospital births, 92% were attended by a physician, and 7% were attended by a midwife (MacDorman et al. 2012).

In contrast, 25% of births take place in the home in the Netherlands where there is a relatively low maternal mortality rate of 6 per 100,000 live births (World Health Organization 2014). For births occurring in a hospital, a midwife attends to the women unless medical interventions are needed. If interventions are needed, including augmentation of labor and pharmacological pain relief, a physician is called in. In 2008, a midwife attended to 60% of deliveries in the Netherlands. While the number of midwife-attended births in the Netherlands has decreased over the eight-year study period due to referral to a physician, birth outcomes did not improve (Offerhaus et al. 2013).

Globally it is estimated that 62% of all births are attended by a skilled health professional (a doctor, nurse, or midwife) leaving nearly 40% of the world’s births unattended by a professional birth attendant. According to the WHO, a skilled health professional attending to women in the peripartum period is crucial in order to get the maternal mortality ratio below 100 per 100,000 live births, a situation that exists in at least 95 nations (World Health Organization 2007, 2015).
Major direct causes of maternal mortality worldwide include hemorrhage, hypertensive disorders, sepsis/infection, and obstructed labor (UNICEF 2008). In the US between 1998 and 2005 the major causes for maternal death were hemorrhage (~30%), hypertensive disorders (~20%), infection (~15%), thrombotic pulmonary embolism (~12%), and amniotic fluid embolism (~8%) (Berg et al. 2010). The four leading causes of maternal morbidity are similar to the causes of mortality but also include obstetric trauma as well as hemorrhage, hypertensive disorders, and infection (Danel et al. 2003).

In addition to these direct causes of maternal mortality and morbidity, there are a number of underlying factors that contribute to mortality and undermine maternal health including access to nutritious food and essential micronutrients, poverty, social exclusion, and gender discrimination (UNICEF 2008). Naraindas (2009:105) writes, "people may die and fall ill not necessarily due to indigenous birth practices (though that too is possible) but to sheer want and poverty and the attendant malnourishment and impossible living conditions. Rather than addressing this, a social problem is medicalized and converted into a medical problem and it is presumed that indigenous practices or ill-trained personnel are what need to be extirpated."

Research on human birth is needed as women, policy makers, advocates, and professional birth attendants (obstetricians, nurses, midwives, and doulas) seek progress in both birth outcomes and the experience of birth (Simonds, Rothman, and Norman 2007; Trevathan 2011). An understanding of how maternal psychophysiological stress is induced or alleviated and what birth outcomes are associated with maternal stress may help reduce adverse maternal and infant outcomes.
Birthing Systems

Jordan (1993) notes that within a given birthing system all the players, the women, her family, and attendants, find the birth practices of their birthing system appropriate and obligatory. Therefore, it is difficult to disentangle what is social production and what is physiologically necessary. A cross-cultural investigation can shed light on what may not be seen from within a single birthing system in order to disentangle the medical-physiological and social-ecological aspects and to gain a biocultural perspective.

Biocultural research on childbirth is needed as traditional birth systems transform into or integrate a Western biomedical model of childbirth. In the US, birth is a medical event, and as a patient, the expectant mother takes on the sick role where she is unable to handle the situation on her own and must seek professional help. The physician then takes the authoritarian role and the patient is expected to trust the physician’s decisions (Jordan, 1993). In the US, 99% of births occur in the hospital where birth and ‘the patient' are professionally managed with heavy dependence on medical technology and pharmacological means of pain relief and for starting and sustaining the labor itself. When women become patients, all authority and decision-making power is transferred to the physician and medical staff (Jordan, 1993). The American system has emerged as a standard for developing nations, yet morbidity and mortality statistics in the US are below expectations. Therefore, a critical look at what are physiological needs and what is social production is required.

Jordan (1993) and others have described birthing systems across the globe that resemble the medical/technocratic/obstetrical model of birth, others that adhere to a midwifery/holistic or indigenous model of birth, and others that combine elements of these birthing systems (Davis-Floyd and Cheyney 2019; Davis-Floyd and Sargent 1997).
Childbirth Cross-Culturally

Childbirth is a relatively new topic in anthropological literature. Until recently the ethnographic record on the process of childbirth was slim, with the few accounts that were available describing pathological or abnormal birth. A review of the Human Relations Area Files by Mead and Newton (1967) revealed little about normal birth. Indeed, Mead and Newton found that little was in the anthropological or medical literature about non-medicalized birth and that most reports were concerned with pathology in extremely abnormal childbirths. Conducting research among the Maya of the Yucatan, Jordan (1978) published the first ethnography on directly witnessed, non-western, normal childbirth. Beginning her fieldwork in 1972, Jordan was able to first witness and then to assist in many births in this population. Extensive ethnographic research on normal non-medicalized, as well as on medicalized, childbirth has been conducted since then (Davis-Floyd and Cheyney 2019; Davis-Floyd and Sargent 1997; Kitzinger 1978; MacCormack 1994; McElroy 2015; Selin and Stone 2009).

Human childbirth is an evolutionarily driven and constrained physiological process that is deeply embedded in cultural, political, economic, and ecological structures. Therefore, childbirth is best viewed through a holistic biocultural lens. Jordan (1993) describes childbirth as a reflexive and universal biological event that is also particular to each society and socially shaped everywhere. Looking at mortality statistics, it is easy to see that birth outcomes are significantly influenced by the overarching environment (including the cultural, political, economic, and ecological structures) in which the event takes place. For example, poverty is an underlying and basic cause of maternal mortality (UNICEF, 2008); however, maternal mortality ratios (MMR) can vary widely based on place. In the early 1990’s, Vietnam, Lesotho, the Central African Republic, and Nepal all had a Gross National Product purchasing power parity (GNP-PPP)
between US$1,000 and $1,200. However, the MMR for each nation varied widely, ranging from 160 to 1,500 MMR (Van Lerberghe and De Brouwere 2001).

When Jordan published the first edition of her book *Birth in four cultures* (1978), little else was written about non-medicalized childbirth. Jordan (1993) describes this lack of data as remarkable due to childbirth being a transformative event for the parents, family, and community with religious, economic, and interpersonal implications. The process of childbirth can be vitally changed by the cultural milieu in which the event takes place. What women should eat and drink, what drugs she should take, what positions she should take, who should be present, to have an induction or elective cesarean section and so forth are all dictated by the overarching environment and the *birthing system* being adhered to (see Davis-Floyd and Cheyney 2019 for recent accounts). The practitioners of the birthing system “will tend to see it as the best way, the right way, indeed the way to bring a child into the world” (Jordan, 1993: 4).

In the US, the dominant model is to birth in-hospital with a physician attendant and ready access to pharmacological means to augment the birth process by the administration of synthetic oxytocin to stimulate or speed up labor (Buckley 2015). A small percent of women seek to avoid this model and adhere to a midwifery-based model with pharmaceuticals unavailable (unless transferred to the hospital/physician model).

*Traditional Midwifery Model*

Beginning her fieldwork in 1972, Jordan was able to first witness and then to assist in many births among the Maya of the Yucatan. The births witnessed by Jordan were attended to by a native lay midwife, who was trained by her mother as well as by a medical doctor and a workshop in Mexico City. In Jordan’s description, elements of traditional midwifery as well as
biomedicine can be seen in the birthing system practiced by the midwife. The births took place in
the home of the parturient or that of her mother, where the birthing women generally labored in
their hammock. In this birthing system, the husband, mother, and other female relatives and
friends of the parturient also assisted in the labor and delivery. Only women who have had a
child themselves are permitted to assist in and view the birth. Therefore, a first time mother is
introduced to the process of labor and delivery during her first birth, and the midwife instructs
the expectant mother as her labor advances. The midwife and other helpers attending the birth
assist emotionally by encouraging the woman with positive affirmations or scolding her for her
lack of strength. They also support the woman physically by holding her, supporting her weight,
and allowing her to use them as physical leverage to bear down. As the baby emerges, the
midwife catches the baby, suctions the mucus from the nose and mouth and lays the baby on the
mother’s abdomen. If complications would arise, the midwife would call on the help of a
physician. However, an account of this occurring is not offered. Jordan states that many births
she attended were easy on the mother with steady progress and little pain while others were
longer and more painful. Her description does not include any indication that she witnessed any
complications other than stalled labor, which was addressed and overcome by simple remedies
prescribed by the midwife. However, the midwife did not make decisions alone. There was much
discussion on what was to be done in terms of stalled labor between the midwife and the helpers.
Based on Jordan’s description, birth in this Mayan community is a social event among those
involved and the expectant mother has a support system to help her through labor, delivery, and
the postpartum period. It was also noted that the midwife would feel for the orientation of the
fetal head and could massage the maternal abdomen to move the baby into position if the head
was not positioned down.
Within the descriptions of midwifery activities some consistencies include giving advice or prescriptions for teas and other remedies, massage of the mother’s limbs or abdomen especially when the baby is not emerging or is turned posterior or breeched, massage or put pressure on the perineum, and offer social and emotional support (Afsana and Rashid 2009; Jordan 1993; Kitzinger 1994).

Like Jordan (1993), Afsana and Rashid (2009) witnessed a birthing system in Bangladesh that relied heavily on the local birth attendants (daini), but medical assistance was available if deemed necessary. Similar to the Maya described by Jordan, the birth described by Afsana and Rashid consisted of the parturient, the daini, and other women from the community. The women supported the birthing mother with talk including telling their personal stories and physical support. Others have also noted similar birth events (Bel 2010; Bel and Bel 2007; Cosmansky 1994; Davis-Floyd and Cheyney 2019; Kay 1982; Kitzinger 1997).

**Pain in Childbirth: Control, Acceptance, and Fear**

Jordan (1993) notes that the experience of childbirth is vastly different in the Mayan community compared to what is conventionally experienced in the US, the Netherlands, and Sweden. Jordan found that even the expression of pain of birth varied among the four cultures she studied. While some women experience less pain than others, pain is an expected part of childbirth. In the US, laboring women express high amounts of unbearable pain (in general) while in the Yucatan and the Netherlands laboring women rarely received any pain medications and accepted the pain as a natural course in childbirth. Conversely, in Sweden, she found that the women rather than the physician decided when to administer pain medications and with this
control managed the pain with “quiet, intense concentration rather than vocal panic and despair” that she witnessed in the US birthing system.

Ohel and Sheiner (2009) found that in their Jewish and Bedouin participants in Israel, the cultural background of the parturient influences behavior and pain management during pregnancy and labor for both the parturient and the medical care provider, but that the actual pain experienced between the two groups was equal. In their study, Ohel and Sheiner found that 89% of participants were offered an epidural, and an epidural was administered to 29% of participants. Of those patients who were offered an epidural, 63% were Jewish and 11% were Bedouin. Physicians in this study were found to significantly underestimate the pain experienced by Bedouin women compared to the women’s descriptions of their own pain, while the physician’s estimate and the Jewish women’s estimate of experienced pain were approximately the same. A similar situation is noted in Greece where three levels of maternity care are available. While Greek women typically pay extra to be admitted to the “Alpha” or “Beta” wards, are attended by obstetricians, and have a cesarean rate of around 65%, immigrants to Greece are typically admitted to the “Gamma” ward, are attended by midwives, and have a cesarean rate of around 25% (Georges and Daellenbach 2019). Morse and Park (1988) found that when a birthing system does not consider birth to be a natural event, the women perceived the pain to be more intense than when birth is perceived as a natural event.

**Birth Attendants**

Jordan (1993) advises that in a biosocial perspective on childbirth the interactions between birth attendants, birth participants, and the parturient should be studied to understand the differences observed. These interactions between birth events in-hospital and out-of-hospital
have been studied ethnographically and studies have been conducted on cortisol levels by mode of delivery in-hospital. A crucial piece of this research that is missing is how cortisol levels vary in- and out-of-hospital.

Jordan (1993) notes that access to witness or participate in a birth event is almost always restricted. In the Mayan community for example, only women who had previously given birth were allowed to attend the birth and the husband was expected to be present; while in the US until recently in the 1970s, expectant fathers were excluded from the delivery room but nulliparous women nurses may assist in the birth. Jordan notes that at least up until the 1990s in the US American women would still go through labor and delivery with only medical personnel present. The universal norm may be described as women being attended at birth with the particulars of who attends being based on socio-cultural norms of each particular birthing system. Indeed, Jordan (1993) and Trevathan (2011) have noted that an entirely unaided birth is rare in human cultures. Jordan (1993) writes, “birth attendants must be seen as an integral part of the event…The very course of labor and birth is constituted interactionally – that is to say, the doing of birth is inseparable from the persons who participate in its production as a locally sensible event” (p. 60).

Unattended births are mentioned in accounts of childbirth practices, although the descriptions are scarce and sparse. One of the first ethnographic accounts was among the Ju/'hoan or the 'Kung of the Kalahari by Lorna Marshall (1976, 2013). Among the Ju/'hoan first births were assisted with subsequent births ideally unaccompanied. In another account, a Tibetan informant stated she had previously given birth with the assistance of her mother-in-law, but she passed before her last child was born, so her husband was with her. However, according to the account, he did not assist her except for handing her the knife to cut the umbilical cord and
cooking food (Craig 2009). Likewise, among the Hmong it is stated that, first time mothers and women experiencing difficult labor received assistance; otherwise Hmong women gave birth by themselves (Liamputtong 2009b).

Recent accounts of childbirth have indicated that while unassisted birth may have occurred in previous generations, the medical model of birth is now dominant where possible. Harvey and Buckley (2009) describe childbirth in China as a system that is moving towards medicalized birth with the wealthiest choosing to have cesarean sections to remove the “uncomfortable physical circumstances in vaginal birth.” However, this is not available to everyone. In 2002, it was estimated that 80% of births occurred in-hospital. In those births that did occur at home it is stated that the women may be unattended, attended by a family member, or by a traditional or modern midwife. Similarly, in Korea, it is stated that women labored and delivered on their own before health insurance started covering childbirth in hospitals in 1975. Now it is estimated that a physician attends 96% of births.

In the US birthing system, birth is seen as medical, uncertain, stressful, painful physiologically difficult and is managed through pharmacological and chemical means and all births are treated as complicated. Alternatively, the Dutch and Mayan system witnessed by Jordan, emphasize patience while letting nature take its course. Further, in the US birthing system women are often viewed as incapable of delivering the baby on their own, while in the Dutch and Swedish system, women are seen as completely capable of birthing on their own, and the attendants are there to watch for complications, give encouragement, and do a few technical tasks.

Jordan (1993) states that the kind of birth attendants that a birth system allows is consequential. She describes two consequential fronts: the birth attendants significantly influence
the way women experience birth, and secondly, the birth attendants significantly influence the medical outcome of the birth. For example, in California, mortality rates at deliveries attended in-hospital by midwives drop significantly compared to physician-attended births in the same hospital (Levy et al. 1971). A study among primiparous low-income Guatemalan women found that when women were accompanied by a doula\(^2\) compared to receiving standard of care, there were lower rates of fetal distress (40% vs. 80%) and shorter lengths of labor (8.8 hours vs. 19.3 hours) (Klaus et al. 1986; Sosa et al. 1980). Similarly, in a case-control study in Texas, 402 primiparous mothers with normal labor were divided almost evenly into three subgroups; those supported by a doula, those simply observed by another women, and the control group with standard of care. Compared to the control group, the supported group experienced less than half the number of cesarean sections, a third the number of forceps deliveries, and a sixth the number of epidurals. Further, even the observed groups experienced fewer interventions than the control group. This phenomenon was attributed to the comfort afforded the parturient by the presence of the other women simply observing (Kennell et al., 1988). Christiaens et al. (2011: 220) found that “both Belgian and Dutch women receiving midwifery care reported less fear compared to those in obstetric antenatal care. Hence, irrespective of the maternity care model, antenatal care providers are crucial in preventing fear of childbirth.”

More recently, Hodnett et al. (2013) conducted a systematic review of randomized control trials that compared continuous support during labor with usual care. Within 22 trials including 15,288 women, they found that those with continuous support were more likely to have a spontaneous vaginal birth, to have shorter labors, and they were less likely to have intrapartum

\(^2\) According to DONA International, which provides education and certification for doulas world-wide, a doula is a “trained professional who provides continuous physical, emotional and informational support to a mother before, during and shortly after childbirth to help her achieve the healthiest, most satisfying experience possible” (https://www.dona.org/).
analgesia and cesarean sections. It appears that in a medicalized environment, companionship during labor and birth is significantly beneficial (also see Bohren et al. 2017).

**Labor and Birth Location**

The birthing system being adhered to prescribes the appropriate location for labor and delivery. This birth territory is *marked* and *specialized* as in the case of clinics, hospitals, or birthing centers. The territory may be *unmarked* and the women’s own space as in the familiar and reassuring home environment of the Mayan community where birth is a normal part of family life. Being moved from ones natural environment can have psychological and behavioral effects. This has been demonstrated in humans and other animals. In Holland, deliveries at home result in lower mortality than deliveries in hospital where either midwife or physician are the attendants. This difference is found to be statistically significant and not explained by differences in maternal characteristics, high-risk births, or low birth weight (Tew and Damstra-Wijmenga 1991). “In cultures where birth takes place in an unfamiliar setting, women usually fear delivery; when it takes place in the home and in the presence of family and friends, women are less fearful” (Trevathan 2011:104). In animals, delivery outside the familiar environment has been found to cause spontaneous abortion, stillbirths, or to impair the mother’s behavior (Rosenblatt 1967). Liamputtong (2009a) notes that in most traditional societies a laboring woman is usually assisted by other women or birth attendants and that the women give birth among those whom they know well and trust.

The findings suggest that acute anxiety due to the environmental circumstances may lengthen labor, while having continuous labor support reduced that anxiety. Similarly, Nommsen-Rivers et al. (2009) found that birthing women accompanied by a doula had their milk
come in (lactogenesis) earlier than did women who received standard care. The authors hypothesize that the early onset of lactogenesis was due to lower stress and specifically lower cortisol levels during childbirth due to the presence of continuous labor support from a doula.

Jordan (1978) developed the concept of authoritative knowledge regarding childbirth decision-making. She found that at any one time and in any given social system multiple systems of knowledge exist, and argues that while these systems of knowledge could coexist, usually one system dominates all others rendering all other knowledge systems illegitimate and irresponsible. She attributes this knowledge domination to structural superiority, where the authoritative knowledge is associated with the more powerful social, political segments of society. Jordan (1993) calls for a mutual accommodation between different knowledge systems of birth, which would require a breakdown of structural superiority surrounding childbirth. She states, “in spite of the magnitude of differences between systems, a problem that specifically does not arise from within stable systems is a radical critical assessment of practices. Self-conscious examination seems to be a characteristic of systems undergoing change” (p. 45).

The American model of birth is one of the most medicalized (or over medicalized) birth systems and this model of birth is being exported globally. However, the mortality and morbidity statistics in the US are in need of improvement and falling far behind public health goals. Davis-Floyd and Sargent (1997:13) write, “In the United States, low standards of prenatal care and high infant mortality in inner cities are juxtaposed against the near-wholesale exportation of the American technocratic birth model to the Third World. Medical claims for the superiority of technocratic birth fail to take into account the demonstrated safety of planned, midwife-attended home birth in many countries…or the enormous health problems generated for mothers and
babies by such basic unmet needs as clean water, sanitary living conditions, and adequate nutrition."

As the literature reviewed above shows, birthing systems can have major impacts on health outcomes. Additionally, in a medicalized environment, continuous maternal care, particularly by a doula, is beneficial. Through the data collected in this study, I seek to continue to grow this body of knowledge and understanding regarding the most conducive environments for physiological normal birth.

**Physiology of Childbirth**

*Fundamentals of the Hypothalamic-Pituitary-Adrenocortical Axis and Cortisol*

The hypothalamic-pituitary-adrenocortical (HPA) axis has the end product of cortisol in humans. The HPA axis and cortisol are understood to be mediators between stressful life events and health outcomes. According to Nicolson (2008:37), “The HPA response is a component of the organism’s adaptive system for maintaining function under changing environmental circumstances.” The HPA axis has three main components: the hypothalamus, the pituitary gland, and the adrenal cortex. Each component releases a hormone that feeds into the next component along the axis. A negative feedback system regulates the HPA axis through circulating cortisol, which inhibits activity in the hippocampus, the hypothalamus, and the pituitary (Nicolson 2008).

The hypothalamus, a small region of the brain located at the base of the brain and next to the pituitary gland, releases corticotropin-releasing hormone (CRH) and arginine vasopressin (AVP), which trigger the pituitary gland to secrete adrenocorticotrophic hormone (ACTH) into the
bloodstream. When ACTH reaches the adrenal cortex, located on the perimeter of the adrenal gland and on top of each kidney in the core of the body, the adrenal cortex is stimulated to release glucocorticoids (i.e. cortisol in humans) into the blood stream and eventually into the saliva. Cortisol enters saliva through passive diffusion. The cortisol in saliva is free cortisol. That is, the cortisol in saliva is unbound and represents the fraction of the hormone that is biologically active.

In cortisol research among pregnant women, one of three measures is most often utilized: total cortisol in plasma, free cortisol in plasma, or free cortisol in saliva (other types of studies have also utilized urine, sweat, or tears as free cortisol can be passively diffused into all bodily fluids).

Free cortisol measured in saliva is highly correlated with free cortisol in blood. “The correlations between free serum and salivary cortisol were greater than 0.9 at baseline and at 30 min.” (Duplessis et al. 2010). However, there is a partial conversion of cortisol to cortisone during passive diffusion. Therefore, free cortisol in saliva represents approximately two-thirds of free cortisol in blood. Further, free cortisol in blood only represents 4-5% of total cortisol released. Approximately, 90 to 95% of cortisol is bound by corticosteroid-binding globulin or albumin. Measuring cortisol in saliva is ideal because free cortisol is the biologically active fraction of the hormone and saliva collection is minimally invasive.

The HPA axis and cortisol levels exhibit a pronounced circadian rhythm (Nicolson, 2008 and Entringer et al. 2011). Even in the absence of stressors, cortisol is released throughout the day in short pulsatile episodes. The release of cortisol is concentrated in the morning hours in people who have a normal routine of nocturnal sleep and daytime activity. Here, cortisol levels
begin to increase several hours before awakening, and then exhibit a sharp increase 30 to 40 minutes after awakening. After this sharp pre- and post-awakening spike, the cortisol levels decrease steadily throughout the day, except for a smaller spike after lunch. Cortisol levels are at the lowest level between 10pm and 4am.

In response to discrete stressful events or stimulus and within minutes, cortisol levels begin to rise superimposed on the basal HPA activity diurnal profile. After the stressor is terminated, cortisol levels return to the baseline state after approximately one hour. When cortisol levels rise, energy is mobilized so the individual can cope with the stressor. Cortisol release is primarily a protective response. Cortisol halts the initial fight or flight responses of the sympathetic nervous system and the immune system to prevent over-reaction and hence protect the individual. When the HPA axis has chronic hyper-activation, cortisol release can be maladaptive and lead to stress-related disorders (Nicolson 2008).

The HPA axis, however, does not respond to all stressors and other physiological systems can be involved in stress response. For example, the sympathetic nervous system may respond to a stressor and elevate blood pressure and heart rate, while the HPA axis remains unresponsive (Nicolson 2008). Three categories of stressors are known to activate the HPA axis and elevate cortisol levels. First, cortisol levels rise in situations in which the individuals perceive themselves to have minimal control or when the situation is perceived as unpredictable. Second, the HPA axis is activated during physical exercise and even more so when accompanied by competition, indicating both a physical and psychosocial component. Thirdly, pain is also known to increase cortisol levels (Nicolson 2008). Stressors from all three of these categories may be experienced during labor and delivery.
Cortisol in Pregnancy

Just as cortisol exhibits a circadian rhythm with normal nocturnal sleep and daytime activity in the absence of a stressor, cortisol also has a distinctive pattern in pregnancy and plays a crucial role in fetal development and parturition (Li et al. 2014). The role of glucocorticoid concentrations in the maturation of fetal organs and the initiation and maintenance of labor has been established in many mammalian species. However, as discussed by Li et al. (2014), the role glucocorticoids play in human parturition is controversial because synthetic glucocorticoids (GCs) have an absence of effect on the length of human gestation. Synthetic GCs are administered to women to accelerate fetal lung maturation but synthetic GCs do not induce labor. Li et al. argue that this absence of effect “may be largely due to the potent negative feedback of synthetic glucocorticoids such as dexamethasone and betamethasone on the fetal hypothalamic-pituitary-adrenal (HPA) axis. In addition the unique role of human fetal adrenal glands in the production of estrogen by the placenta, which is the prerequisite for the transition of a quiescent to an active state of myometrium in initiation of parturition, may influence the effect” (p. 292). The authors find that estrogen may need to be at high concentration levels within the intrauterine tissue for GCs to initiate parturition. Cortisol levels rise in conjunction with estrogen in maternal and fetal circulations and in the amniotic fluid during gestation and ultimately play a crucial role in the initiation of parturition in humans, according to Lie et al. (2014)

Cortisol is a known immunosuppressant, and therefore rising cortisol levels may be an important factor in pregnancy-associated immunosuppression, which may function to protect the fetus with the side effect of reduced resistance to primary infections or loss of established immunity to disease. One experiment showed a loss of previously existing immunity during
pregnancy to malaria with increased serum cortisol levels. A loss of immunity did not occur when the rise in serum cortisol concentration was prevented (Vleugels et al. 1986).

Cortisol levels in both amniotic fluid and maternal plasma have been found to increase with gestation length. Blankstein et al. (1980) and Sippell et al. (1981) found that amniotic fluid (AF) cortisol rose steadily from 9 weeks gestation to 38 weeks gestation. Blankstein et al. tested 89 samples of amniotic fluid (AF) and found the median concentration of unconjugated AF cortisol concentrations rose from 6.5 ng/ml at 9-20 weeks gestation to 13.9 ng/ml at 28-37 weeks gestation. Sippell et al. tested 70 AF samples and found that AF cortisol levels correlate with fetal but not with maternal serum concentrations, indicating that AF levels reflect fetal hormone secretion and metabolism and are indicators of the hormonal environment of the fetus in utero. Sippell et al. found that the concentration of unconjugated cortisol levels averaged from 5.96 ng/ml at 14-16 weeks gestation with a substantial and continuous rise with peak levels of 60.8 ng/ml 36-38 weeks. Thereafter AF cortisol level declined to 23.0 ng/ml at term.

A cortisol level rise with gestation length has also been documented in maternal plasma and saliva. Vleugels et al. (1986) found that maternal serum cortisol concentrations exhibited a steady increase from 8 weeks to 38 weeks gestation and the data exhibited a linear relationship between cortisol and gestation. There was a statistically significant difference between nulliparous and multiparous women (p = .001) in 527 healthy pregnant women (105 nulliparas and 422 multiparas). Vleugels noted that there was a wide range of cortisol levels.

Jones et al. (2006), in agreement with the previous work mentioned, found that mean maternal salivary cortisol levels rose with the increased weeks of gestation. The authors found a slight but non-significant AM cortisol increase from 0.519 ug/dL at 15-19 weeks to 0.565 ug/dL
at 24-27 weeks (P = 0.32) and a significant PM cortisol increase from 0.139 ug/dL at 15-19
weeks to 0.186 ug/dL at 24-27 weeks gestation (P = 0.006). Jones el al. also found the expected
increase in AM cortisol compared to PM cortisol (0.56 vs. 0.16), and on workdays vs. non-work
days (0.610 vs. 0.521 P < 0.001). Finally, Jones et al. found a slight but insignificant difference
in multiparous and primiparous women (0.558 vs. 0.531 P = 0.19).

**Cortisol in Parturition**

Cortisol levels have been established to vary in amniotic fluid, maternal serum, and
maternal saliva based on gestation length with cortisol levels rising through pregnancy with a
drop at full term. Cortisol levels have been found to then increase again with the initiation of
labor. Willcox et al. (1985) found that cortisol rose in concentration from 4.5–5.5% to 7.2–8 2%
during labor and similarly Wladimiroff et al. (1983) found that cortisol levels increased from
pre-labor (1053 nmol/l) to the end of the first stage of labor (1245 nmol/l). Neither study found a
significant difference between spontaneous and induced labor.

While the trajectory of cortisol reactivity in pregnancy and parturition has been well
established, there have been mixed findings in regard to cortisol levels and the mode of delivery.
Onur et al. 1989 measured maternal plasma cortisol in 30 healthy multiparous women. The study
included three groups, 1) oxytocin induced labor without meperidine for pain relief, 2) oxytocin
induced labor with meperidine, and 3) controls who did not receive any medications. In all three
groups, cortisol levels increased during labor and peaked at delivery. The cortisol levels were not
significantly different between the two groups without meperidine (group 1 and 3), but
significantly lower in the group that was administered meperidine (group 2). Similarly, Alehagen
et al. 2001 found that cortisol levels ceased to continue to rise once analgesia was administered
(66.28 ± 33.53–63.53 ± 31.86 pmol/ml), while cortisol levels continued to rise in those not administered analgesia (52.35 ± 30.62–99.95 ± 53.84 pmol/ml; p < .0001).

Talbert et al. (1973) and Goldkrand et al. (1976) found no significant difference in maternal plasma cortisol levels between those who delivered vaginally and those who had a cesarean section, and thus concluded that cortisol levels may not be associated with mode of delivery. Alternatively, Cawson et al. (1974) found significant differences based on mode of delivery. In non-laboring elective caesarean sections, the average cortisol levels was 308 ng/ml, in spontaneous labor with a vaginal delivery the average cortisol level was 410 ng/ml, and in induced labor with a vaginal delivery the average cortisol level was 625 ng/ml.

Women are at increased risk for an emergency cesarean section when labor is induced and when an epidural is administered. Thorsell et al. (2011) found that nulliparous women had a 3-fold increase and multiparous women had a 2-fold increase in the odds of having an emergency cesarean section when labor was induced compared to women who had spontaneous labor. The majority of women who were induced received an epidural. Of the nulliparous women, 99% received an epidural, and 63% of multiparous women received an epidural compared to 48% and 20% of women with spontaneous labor, respectively. Research by Alehagen et al. (2001) indicates that a cortisol rise ceases with the administration of analgesia. Therefore, the question arises, does analgesia by way of ceasing cortisol reactively stall or in some way alter labor leading to an increased risk of intervention and are increasing levels of cortisol adaptive and necessary for the natural progress of labor? Further, when are cortisol levels too high? Burns (1975) found that high cortisol levels were correlated with prolonged labor (P < 0.01), and he suggested that too high cortisol levels might lead to labor complications.
Further research is needed on the topic of cortisol reactivity and birth outcomes. All the studies discussed here took place in a clinical setting. Therefore, cortisol reactivity in home environments is virtually unknown. Further, many variables are lacking in these studies including maternal cortisol levels prior to labor for the majority of the studies. Studies have shown that maternal characteristics are significant contributors to maternal cortisol levels. For example, Thayer and Kuzawa (2014) found that women with higher material deprivation scores had significantly higher evening cortisol in late pregnancy (P = 0.02), and a trend toward elevated morning cortisol (P = 0.09). Therefore, a holistic approach is needed to better understand cortisol levels and cortisol reactivity and the implications for pregnancy, labor, and delivery as well as to understand the hormonal biology of physiological normal birth.

Measuring Cortisol in Pregnant Women

Jones et al. (2006) describe obtaining cortisol samples from pregnant women who collected the samples themselves. The participating pregnant women collected urine and saliva samples at home twice a day over three consecutive days. The women further wore an ambulatory blood pressure monitor for 24 hours and kept a daily diary. Jones et al. were able to collect cortisol samples from 2318 women while 534 refused to participate or did not return the samples. While the authors had concerns there would be problems with an ‘at-home’ data collection protocol due to participants’ discouragement from such a task or due to failure to return the samples, they found the protocol to be successful. Jones et al. attributed their success at collecting the samples to three aspects of the study design. First, they established rapport and trust with the participants during in-depth interviews and took biological samples during the interviews before the at-home protocol was discussed in detail. Further, the protocol was
reinforced through in-person and pictorial instructions, follow-up telephone calls, and at-home cues (i.e. baskets in the bathroom, and reminders that adhere to the refrigerator). Lastly, the participants were offered extra money for completing and returning the at-home samples.

Similar to Jones et al. (2006), Entringer et al. (2011) obtained cortisol samples from pregnant women who collected saliva samples over a 4-day at-home collection period. The participants were asked to collect saliva samples seven times a day over a 4-day period. The study included 25 participants with 700 expected saliva samples. Only 16 samples or 2.3% of the expected samples were not returned. Based on electronic monitoring of sample collection time, 92% of samples were taken within 20 minutes of the expected collection time.

McCool et al. (1994) collected salivary cortisol samples from 38 pregnant adolescent participants. Their protocol did not include at-home collection. The samples were collected from each participant twice during pregnancy. The first sample was taken at < 20 weeks gestation, and the second sample was taken between 32 and 36 weeks gestation. At both sampling times three samples were obtained. The first sample was obtained at 9:00 am, followed by one at 9:20am and at 9:40am. Participants were also administered psychological questionnaires during their visit. The participants were recruited from a prenatal clinic over a one-year period. Of those eligible for recruitment, 51% (n=38) participated in the study, and 33 participants completed the entire study. The five participants who did not complete the entire study experienced early delivery (n=4) or intrauterine fetal demise (n=1).

In summary, the use of saliva samples to measure cortisol has been well established (Hoyt and Granger 2020; Nicolson 2008). Data collection with pregnant participants has been approved (McCool, Dorn, and Susman 1994). Additionally, the reliability of at-home sample
collection methods for salivary cortisol with pregnant participants has been verified (Entringer et al. 2011; Jones et al. 2006).

Cortisol levels in non-human primates have also been analyzed. As in humans, bonobos (Behringer et al. 2009) and other diurnal primates have been shown to have a diurnal rhythm (Elder and Menzel 2001). Behringer and colleagues tested cortisol levels among a captive bonobo population where one female was pregnant. The bonobo population was socially split into two groups, naturally creating case and control sampling groups. The bonobos were trained to chew cotton wool and to give the samples back to the researchers. Behringer and colleagues found that the cortisol levels did indeed follow a diurnal rhythm with elevated levels in the morning and a decrease throughout the day. Further, the authors found that the cortisol levels were elevated in the entire social group in which there was a pregnant female compared to the social group without a pregnant female, and the cortisol levels continue to follow a diurnal rhythm in both groups and in the mother.

Perinatal maternal cortisol will be examined in my research by collecting saliva samples from homebirth mothers. Because salivary cortisol research had only previously been conducted in-hospital, I first set out to see if homebirth cortisol research was feasible. Such research is critical to maternal care because as Benfield et al. (2014:66) stated a comprehensive understanding of cortisol and parturition is still lacking - “in nonlaboring states, high levels of cortisol may reflect intermittent or acute stress, while during labor, high levels of cortisol may be adaptive. But how high and for how long cortisol increases should be considered within normal range or adaptive is unclear. Furthermore, the effects on labor progress of cortisol-altering interventions are virtually unknown. Both questions are worthy of further exploration.”
CHAPTER THREE: MATERIALS AND METHODS

The study was carried out in sections (A, B, and C) and these sections are chronological in time, with A occurring before B and B occurring before C (Figure 2). The women who participated in the different sections do not overlap; thus, each section is represented by a different cohort of women. However, all the participants were non-nulliparous; that is, they had given birth to at least one child when they began their study participation. I first conducted section A and then B as preliminary research to test the study protocols and to have a good sense of my study population before I fully emerged into section C. The study was approved by the University of South Florida Institutional Review Board (IRB #: Pro00026293). The study was funded by the University of South Florida Creative Scholarship Grant.

Figure 2: Study design
Study Section A: Online Survey

As the initial step of the study, I posted an online survey to three Facebook pages. These pages were specifically for the support and education regarding homebirth; thus, all participants were engaged in the homebirth online community. Therefore, it is acknowledged that the results are not applicable to the wider US birthing community but are limited to individuals who are interested in the topic of homebirth, whether or not they have experienced homebirth themselves. The survey asked participants about their general demographics (age, education, race/ethnicity, marital status, employment status, household income, and religious affiliation) and in an open-ended question (unlimited character text box) to “Please describe your birth experiences.” All questions were optional.

I used SurveyMonkey to design and publish the survey online. The survey link was posted only once to each of the three Facebook pages as the survey’s only source of recruitment; however, the survey was re-shared by many members of the Facebook page community. After one week, the survey ceased to receive new participants.

Survey data were analyzed through a qualitative thematic analysis (TA) inductive approach (Braun and Clarke 2006, 2014). This approach is data-driven in that I did not approach the data or themes with preconceptions or attempt to fit the narratives into a preexisting coding frame. The categories and themes evolved through the coding process. I first read each birth experience narrative provided by the participants and hand-coded the narratives to establish the repeated themes across the narratives. Based on the reading and re-reading of the birth experiences, six unique themes emerged and encapsulated what the women described as a positive birth experience or a desired birth experience, which were categorized as “what women want.” The themes are as follows: 1) Be Respected; 2) Find Empowerment; 3) Create
Atmosphere; 4) Have Autonomy; 5) Follow Instincts; and 6) Keep Baby Close (see results for detailed descriptions of each theme).

Additionally, many responses contained a narrative regarding a negative experience during a hospital birth. These narratives were coded as “Dissatisfaction with hospital birth” without any themes. I could have selected to focus on what women disliked or found dissatisfaction with during their birthing experiences as many themes could have been identified in the narratives; however, for now, I have selected to focus on what women want in order to highlight how childbirth in the United States can be improved for the health and well-being of the mother and child.

After the initial reading and hand-coding of the narratives, the survey data were coded using the themes described above using Dedoose. Some responses were very short. For example, “midwife assisted homebirths” or “Father caught with midwife assisting.” Some responses contained more details but lacked any opinion or feelings about the experience. For example, “At a hospital both times, with a midwife catching baby. First birth I had pit and an epidural, vaginal birth. Second birth was completely natural, not even IV fluids” and “planned a home birth with midwife, transferred at the last minute (BP was "legally too high" for home birth) OB at hospital caught the baby, born naturally.” These responses did not meet the inclusion criteria and were not coded. The participants’ responses were coded when the mother indicated her emotions, feelings, or desires regarding the birth. For example, “My first three births were in the hospital...I wasn't treated the way I felt I should've been. I was treated like I was incompetent. My 4th baby, I decided that home birth was the best choice for my baby and our family. It was the most beautiful, empowering thing ever, and I felt so respected and loved.” This response was coded as a) Dissatisfaction with hospital birth, b) Find Empowerment, and c) Be Respected. Within each
data item (i.e. each individual narrative), each theme was only used once. So, if a participant indicated in multiple ways that she desired to be respected and she indicated just once that she desired to be empowered, the code was still applied once for Be Respected and once for Find Empowerment within that data item. Thus, the summary statistics in the results section do not account for how many times the theme was mentioned but how many women mentioned each theme in her narrative.

**Study Section B: Biological (Saliva) Samples**

As the second step in the study, I created a protocol for collecting saliva samples at home during the peripartum period to measure maternal cortisol reactivity to labor (see Appendix D: Perinatal saliva collection protocol). Salivary cortisol sampling is easy and non-invasive. Salivary samples are advantageous compared to blood sampling, as blood sampling is excessively invasive compared to saliva sampling. Further, the cortisol in saliva is ‘free’ or unbound by corticosteroid-binding globulin (CBG). This is advantageous as the biologically active fraction of the hormone is represented in the free cortisol.

Several different methods for collecting saliva samples are available. Nicolson (2008) suggests using cotton swabs to reduce participant burden. Adequate amounts of saliva are collected in 1 to 2 minutes using swabs compared to 1 to 15 minutes using passive drooling. Strazdins et al. (2005) found that cortisol levels collected with swabs were significantly lower than in samples collected via drooling but concluded that both methods are viable. Recent research protocols with pregnant participants have used the cotton swab method for collection at home (Entringer et al. 2011) and in the hospital (Alehagen et al. 2001). Other study designs have
also utilized this method, including research with bonobos (Behringer et al. 2009) and research with mother and baby pairs (Thompson and Trevathan, 2008).

One local midwife was supplied with the protocol sheet seen in appendix D and four saliva collection kits. Each kit was an insulated bag containing Salimetrics Salivabio Oral Swabs and swab storage tubes along with a permanent marker and labels to identify each saliva sample. Upon visiting with each participant for a regular check-up, the midwife left the saliva collection kit with the mother in her home so that the mother may collect her saliva during the earlier stages of labor prior to the midwife’s arrival.

The timing of the saliva collection was not exact but was left up to the laboring mother and her midwife’s judgment. The instructions were as follows: take one sample in early labor, another sample as you feel labor progresses, take a third sample as you feel delivery is near, take a sample approximately 30 minutes after delivery, and take a final sample approximately 12 hours after delivery or the morning following delivery. These instructions were devised with the hope of capturing the steady increase in cortisol as labor progressed and capturing the peak cortisol levels at the moment of birth.

In order to validate the protocol before Study Section C commenced, the saliva samples were sent to Salimetrics in California and assayed for cortisol. The protocol was successful. I also discussed the protocol with the midwife who attended all four births, and the protocol was deemed doable and non-invasive for the laboring participant. The cortisol results from these four births can be seen in the results sections and are labeled as participants A – D.
Study Section C: Standardized questionnaires, interviews, and saliva samples

Study sections A and B were preliminary steps to study section C. Once I had collected the written narratives via the online survey and collected saliva samples via a midwife, as the third step in the study, I wanted to have direct contact with the research participants to complete the ethnographic process. For study section C, I selected two standardized questionnaires to be completed pre- and postnatally, devised face-to-face interviews to be completed pre- and postnatally, and created a protocol for saliva collection prenatally and perinatally (refer back to figure 2 for an overview of the study design and number of participants).

Standardized Questionnaires

Validated standardized questionnaires were selected to measure the participants’ general level of anxiety, present moment level of anxiety, and fear of childbirth. The participants were asked to complete two questionnaires antepartum and two corresponding questionnaires postpartum. The State-Trait Anxiety Inventory (STAI) and the Wijma Delivery Expectancy/Experience Questionnaire (W-DEQ) were chosen because each questionnaire has been validated with pregnant women and has previously been used in conjunction with cortisol research (McCool et al. 1994; Schmidlin et al. 2012). Permission to use each questionnaire was granted by Mind Garden, Inc. and Klaas Wijma, respectively. Further, these two questionnaires have been chosen because both can be utilized before and after a given event, such as childbirth.

The State Trait Anxiety Inventory (STAI) (Spielberger 1983) was used to measure the participants’ anxiety levels. In the inventory, anxiety has been classified into two domains: state and trait anxiety. The State Anxiety Inventory asks the participant how she feels right now
compared to the Trait Anxiety Inventory, which asks the participant how she feels generally. Each domain has 20 questions associated with it, which are measured on a four-point scale. The entire inventory is a 40-item, self-report instrument. A higher calculated score indicates greater anxiety levels. The inventory has been used in multiple studies with pregnant women, and Gunning et al. (2010) have validated this measure among pregnant women. McCool et al. (1994) used this inventory in their research on anxiety, cortisol, and perinatal outcomes among primiparous adolescents. McCool et al. found that anxiety scores were lower in participants who delivered at term compared to those who delivered premature or post-term (p< 0.05). In a meta-analysis on anxiety and perinatal outcomes, Littleton et al. (2007) found no evidence of an association between anxiety symptoms and adverse perinatal outcomes. However, the authors note that many gaps exist in the literature, and more research is needed. The meta-analysis (Littleton et al., 2007) found the STAI to be the most frequently used measure on psychological stress and perinatal outcomes.

The second antepartum questionnaire administered was the Wijma Delivery Expectancy/Experience Questionnaire (W-DEQ) (Wijma, Wijma, and Zar 1998). The antepartum or expectation questionnaire (version A) is matched with a postpartum or experience questionnaire (version B). Wijma et al. state that this questionnaire was developed to look at ‘fear of childbirth’ specifically, where other questionnaires used at the time looked at anxiety in general (such as the STAI). Wijma et al. argue that fear of childbirth is its own psychological domain. An instrument that measures this specific fear was needed to establish the participants’ expectations about the delivery, which is relevant to her experience of the delivery. The theory behind fear of childbirth and the W-DEQ questionnaire was developed in line with Lazarus’ (1982) theory that appraisal processes are a primary factor in how people react to environmental
stressors. Each W-DEQ (version A and B) contains 33 items that are rated on a six-point Likert scale, which is labeled “extremely...” on one end of the Likert scale and “not at all...” on the other end. For example, question 1 asks, “How do you think your labour and delivery will turn out as a whole?” On a 1-6 scale, the participants are asked to rate her personal feelings and cognitions on the question from “extremely fantastic” to ‘not at all fantastic”. This same approach is taken for all 33 items. A higher calculated score indicates a greater fear of childbirth.

The STAI and the W-DEQ questionnaires were used antepartum and postpartum in this study to determine state and trait anxiety and fear of childbirth. Wijma et al. (1998:84) state, “Feelings of uncertainty and anxiousness may arise from the woman’s experience of being captured in a situation where she faces the approaching delivery, which is unknown, uncontrollable and unavoidable. For some women this situation is psychologically so distressing that it generates fear of childbirth.” Many other questionnaires are available to measure fear and anxiety (Littleton et al. 2007). I chose the STAI and W-DEQ for this study, in part, because this study incorporates cortisol levels and in-depth interviews antepartum and postpartum, and the nature of these questionnaires permit analysis between the antepartum and postpartum administration.

Face-to-Face Interviews

To build upon the results from the online survey (study section B) and to obtain a comprehensive understanding of the participants’ childbirth experiences, face-to-face interviews were conducted and recorded with each participant as a way to capture the oral history of the childbirth experiences of the participants. In-depth, ethnographic interviews were conducted
twice with each participant. The interviews were used to understand how each participant perceives childbirth, and to document, antepartum, her desired childbirth experience and, postpartum, her actual childbirth experience. The interviews were also used to document each participant’s attitudes, knowledge, perceptions, and behaviors as well as to obtain demographic information and personal histories.

Standardized questionnaires can lack construct validity in that the meaning the researcher intends to convey and the meaning assumed by the participant may vary (as described by LeCompte and Schensul, 1999). The questionnaires selected for this research have been validated with pregnant women. Still, in-depth interviews offer insight into the thinking and feelings of the participants beyond the survey. Surveys can lack contextual and historical data that may illuminate why the participants respond to survey questions as they do, and interviews in conjunction with surveys can be used to corroborate participants’ answers (LeCompte and Schensul 1999).

Antepartum questions included: 1) Describe your desired birth experience. This question included probes such as where would you like to be during labor and during delivery, who would you like to be with you during labor and during delivery, what positions would you like to be in during labor and during delivery, and what interventions do you desire? 2) Describe your past birth experiences. This question will included probes similar to those mentioned above. Where were you during labor and delivery, who was with you, what positions did you take, what interventions did you have? Postpartum interviews aimed at capturing how the participants’ births occurred, and the participant was simply asked to describe her birth experience. The goal of the interviews was to have a qualitative documentation of the participants’ experiences of
childbirth including the cultural context, the personal decision-making, and their feelings about
the experience.

Salivary Samples

The saliva collection protocol in study section C is in part the same as in study section B. 
However, additional saliva samples were requested from the participants in the antepartum
period (see Appendix C: Prenatal saliva collection protocol). The saliva samples were used to
assess the participant’s cortisol levels antepartum and intrapartum. The objective in using
samples to measure cortisol levels in each participant antepartum is to establish a baseline
cortisol profile before labor begins. The objective in measuring cortisol levels intrapartum, as in
section B, is to establish how each participant’s cortisol levels change with labor progression
through childbirth.

Based on recommendations by Jones et al. (2006), Nicholson (2008), and Entringer et al.
(2001), during the prenatal saliva collection, each participant was asked to collect four saliva
samples over a four-day period. Nicolson (2008:41) states, “a conservative approach would be to
obtain reliable measures of cortisol basal levels, diurnal slopes, and the CAR in the same
protocol,” and this is the approach utilized here. Participants were asked to take the first two
samples in the morning, one at awakening and one 30 minutes after awakening. These
measurements were used to establish the cortisol awakening response (CAR) in each participant.

CAR may be either heightened or diminished due to chronic stress, depression, burnout,
or other disorders (Nicholson, 2008). Entringer et al. (2011: 472) found that, “women who
delivered an infant at 36 weeks of gestation had 13% higher salivary cortisol levels at awakening
compared with women who delivered an infant at 41 weeks gestation.” Entringer et al. suggest higher salivary cortisol levels may be an indication of dysregulated maternal-fetal-placental neuroendocrine system. Therefore, research on CAR and maternal psychological state may provide insight on birth outcomes. Further, participants were asked to take saliva samples after lunch or dinner and before bed. These measurements, in conjunction with the morning measurements, will be used to establish the diurnal slope of each participant. Nicholson (2008) recommends collecting data to establish the diurnal slope in all cortisol studies. Similar to CAR, the diurnal slope, specifically the steepness of the decline from morning to evening in cortisol levels, may be correlated with the maternal psychological state. A flatter slope has been seen with various psychological disorders (Nicholson, 2008), including fatigue in breast cancer survivors, for example (Bower et al. 2005).

As in study section B, during the perinatal period, participants were asked to take saliva at the following times: 1) in early labor, 2) as contractions increased, 3) when delivery was near, 4) around 30 minutes following delivery, 5) and the morning following delivery (or around 12 hours after delivery) (see appendices C and D for a copy of the protocol sheets supplied to participants).

Each participant was given a saliva collection kit, which included detailed directions on sample collection and storage, 16 dental swabs and storage tubes to collect four samples over a four-day period, and an additional five swabs and storage tubes to collect three samples during labor and two postpartum.
CHAPTER 4: RESULTS

Results from study sections A, B, and C will now be presented (refer back to figure 2 for a summary of study sections). In total, 102 written narratives were analyzed via thematic analysis (study section A); 112 maternal saliva samples were assayed for cortisol (study section B & C); five sets of questionnaires were analyzed for anxiety and fear of childbirth scores (study section C); and five sets of oral narratives were recorded (study section C).

Study Section A & C: Written and Oral Narratives

The online survey obtained 226 responses. All of the questions in the survey were optional, and 187 participants responded to the open-ended question: “Please describe your birth experiences.” Among these responses from study section A, 102 written narratives contained enough detail to be analyzed and coded. Additionally, five sets of oral narratives were recorded during study section C. Two research questions were applied to the responses: 1) how do non-nulliparous homebirth mothers describe, qualitatively in an open-ended format, their desired birth experiences, and 2) does this qualitative data lend evidence for or against the obligate midwifery hypothesis?

Based on the self-selected characteristics of the population whose responses were coded, the population of respondents was fairly homogenous, with 89% aged 21-39, 87% having a postsecondary education, 96% identifying as White, and 82% as Married. Employment and
religious affiliation were split more down the middle, with 47% identified as a homemaker with no other outside work and 48% identified as employed or self-employ; 59% did not consider themselves religiously affiliated, while 40% did.

Figure 3. Thematic analysis results

The themes I identified and the percent of responses that contained the theme can be seen in Figure 3. I will describe each theme and give an example of the theme taken from the respondents’ birth experience descriptions. More than one theme may be present in each quote because I chose to include the full spirit of the statement.

**Be Respected** as a theme was applied when a responded stated she experienced or desired the following: a) to be respected, b) to received help or support when needed, c) to be treated well, with love, or care, d) to be given space or privacy when needed. The definition of
‘when needed’ is crucial here as the participants described both needing support and needing space, but emphasized that timing on the part of the care giver was crucial.

In the following two quotes, the mothers describe the respect they received while laboring and birthing at home. Note how they were empowered by their experiences:

“At home my baby and I were treated with love and respect and we were given our space and privacy. I was surrounded by loving support and respect. I felt empowered, confident, and strong. Birth was peaceful and beautiful. My babies were alert and nursed immediately and checked out perfectly. I was able to do everything my way and had ALL my desires honored and respected”

“My labor was perfect. I felt supported, encouraged, and never alone. I prayed and leaned on the Lord a lot when I felt I could no longer continue. I knew going natural would be best for baby and me. I didn’t want unnecessary drugs in either of our systems—I wanted a pure, untainted moment with my baby and husband…that’s exactly what I got. It was the most difficult thing I’ve done in my life, but also the most rewarding. I felt a huge sense of peace and accomplishment at giving birth naturally and bringing my daughter into the world in a warm, familiar, loving environment. I wouldn’t change a thing!”

The following two short quotes illustrate the desire to be given space when needed. The second quote also illustrates how the midwife respected the mother’s ability to care for her baby.
“I realized that I want the support and care of a midwife, however, birth is private for me”

“My Midwife did not catch my baby, she gave me the opportunity to reach down and grab her and pull her to me by myself”

The following quote shows that the mother perceived that she was respected and attributed this to the ease of her birth.

“My home birth was amazing. I was surrounded entirely by people who cared about me and knew more than what they could read on a chart. They loved on me and guided me to allow my body to work the way it is designed to work. My labor was significantly shorter than my hospital births...and the recovery period was quite easy”

Find Empowerment as a theme was applied when a respondent stated she experienced or desired the following: a) empowerment, b) an amazing, beautiful, incredible, rewarding, satisfying, or redeeming experience, c) to not feel tired after the birth, d) to feel relief from post-partum depression (PPD) or post-traumatic stress disorder (PTSD) or to help heal from a previous experience, e) family bonding or the husband or family member catching the baby.

In the following two quotes, the mothers describe how they were empowered by their birth experiences. It is evident through these quotes that empowerment is in part a product of the
respect received from those attending the births. In the second quote, it also becomes clear that mutual respect was established between the mother and midwife before labor began.

“Amazing, magical, empowering experience. Was less stressful because I didn't have to travel. Felt in control and relaxed. Was lovely to be in the comfort of my own home. Felt cared for as had two midwives with me throughout monitoring my progress. Great bonding experience especially for my other children who were asleep upstairs at the time and met my baby when he was just minutes old.”

“I felt totally in the driver's seat about my birth experience which felt incredible. I did not feel fear, I was actually excited to give birth...Had such a deep connection with my midwife and felt like I was in the best of hands. The birth was exhilarating! Afterwards I felt like a million bucks, like I could do anything. The hormonal release of oxytocin was so intense and lasted for days. Also waited to cut the cord until after it had stopped pulsating...She was born into such a peaceful and loving environment with only a few people to welcome her, it was so intimate and beautiful...It truly was the most empowering day of my life.”

The following quotes further exemplifies how respect from those attending a birth leads to empowerment and further how this respect and empowerment can lead to healing.

“what I really wanted, but didn’t know how to ask, was for encouragement! support! love! suggestions, someone to spend 15 min with me,
even just to hold my hand!...my second birth really helped me heal...I birthed my second...at home! under my own power! I TRUSTED in myself, as a birthing woman. TRUSTED in my body. I only had loving people around me, who truly meant well, to support me...he was born in my birth pool, surrounded by so much love, calmness, dim lights, and people who truly loved their job...noone took him away from me. I finally felt empowered in my body, myself, and birth”

“I had my second child...at home with my husband and midwife...I had such a wonderful experience. I felt so amazing after the birth, not tired and miserable like I did with my hospital birth...I fall short of calling the natural childbirth that I had always wanted, 'easy'. It was perfect. I am grateful for both experiences. If I had not had such an awful time at the hospital, I may not have sought the help of a midwife to achieve what birth should be”

“2nd at home was fun and exhilarating--that's how I would describe it. It was just as much about greeting my babe, but on top of that it was about feeling powerful and amazing as a woman and mother...it was much more uniting for us as a family instead of stressful and dividing”

Create Atmosphere as a theme was applied when a respondent stated she experienced or desired the following: a) a relaxing, peaceful, beautiful, lovely, pleasant environment which could include music and lighting, b) to determine who was or was not present, which could
include a midwife or other attendant who was calm and knowledgeable, c) to be able to eat, drink, take a bath or shower or find comfort in her environment.

The following three quotes demonstrate how the mothers created the atmosphere they desired and that were specific to them.

“I had a mirror set up to watch her descent. The end was all so calm and relaxed. I gave birth on the floor over a couple of towels while leaning against our bed. This was the most comfortable place for me, down on my hands and knees. We kept the lights off in the room, so it was nice and dark with only light coming in from the bathroom...Everything was very quiet and peaceful and I would never do it any other way...a safe, quiet birth at home where I felt secure and was allowed to give birth unmolested and uninterrupted”

“I had a wonderful, peaceful, powerful home birth. I was able to use my breath and sounds to go through each contraction, which was an intense sensation, but not acute pain. Pushing came as a relief as I was able to use my body to do something through the contractions vs just trying to relax through them. I pushed for about 45 min and birthed a beautiful baby girl, on our bed, in our bedroom, to candles and soft music. It was my dream birth came true and taught me more than ever than our bodies can do it, we just need to trust”

“I did it myself with my husband and my best friend present. Candles, affirmations, sushi, walking, joking, loving and laughing. I was totally in control of the experience and that’s why I will birth like this again and again”
The following two quotes demonstrate how the mothers desired to find physical comfort in their environment, specifically by moving around the house.

“I labored all over the house and gave birth in the nude with my husband right there snuggling up behind me. He and the midwife breathed with me through each contraction, which really helped me get through the pain”

“It felt good to sway my hips and walk around. I bent over during every contraction and whoever was closest would apply pressure to the small of my back. That last thing I felt like doing was sitting and it actually made the surges more painful. Moving around was something I hadn’t been able to do in my first birth since I was confined to a hospital bed. The contrast in the two births was remarkable”

“the birth was nice, I was able to move around (unlike my hospital birth where I was confined to a bed), eat (they starved me for my 27 hour labor at the hospital), and use my own herbal remedies. The midwife left me alone until I asked for her, and asked me before she implemented any interventions...my son was not taken from me until I got up to use the bathroom”

The following quote may encompass the themes, but I want to highlight this quote here because this participant describes how she labored in positions that were right for her and that she had the midwife present that she felt comfortable with.
“I wish I had delivered all of my babies at home, without medical intervention...I loved being able to labor in whatever position I wanted, in the comfort of my own home. I loved that my baby was handed to me directly after birth and stayed with me for a couple hours. I loved that the cord remained intact until it stopped pulsing, allowing my baby to receive all of his blood. I love that my midwife was so supportive and felt genuine joy at the birth of my baby...From beginning to end, I can-not say enough about home birth! It was such an amazing experience!”

Have Autonomy as a theme was applied when a respondent stated she experienced or desired the following: a) to be in control or to be the decision maker regarding her experience, b) no drugs or other medical interventions that are not consented to, c) to be unhurried or to be allowed to labor at her own pace.

The following two quotes exemplify how the mothers felt in control during their labor. Particularly in the second quote, the participant expresses how feeling in control of her circumstances, which also included the atmosphere she had created, allowed her to birth with more ease.

“I knew that I wanted to experience natural childbirth...It was an empowering experience to say the least. I always felt in control, never out of options or like I was being pressured with fear to make a certain choice. I could move at the pace that was best for me and the baby”
“The birth experience was amazing, and the baby was never taken from me. My midwives even waited to weigh him until the following day so he didn’t have to be out of my arms. Throughout the labor I consented to intermittent fetal monitoring with a doppler, labored in the birth pool, and was fully supported by my husband and two midwives. I had candles lit and music playing. I was spoken to in gentle tones with gentle words, my caregivers offering suggestions and not commands. I was in pain but I still felt very empowered...I have since felt that because I was in control of so many aspects of the birthing environment, it was easier to surrender to the process”

The next three quotes illustrate how the respondents desire to avoid interventions.

“I birthed at home to avoid unnecessary interventions and non-evidence based hospital protocols; to be able to be upright and active in labor...to give birth in the position that I felt best and most conducive to the swift, easy birth of my babies; to maximize my changes of having a normal, physiological, undisturbed birth by being in a calm, quiet, dark, private environment; to protect my babies and myself from hospital-based infections and to give them the gentlest welcome possible (no premature cord clamping, no separation of mother and child, immediate skin-to-skin contact, delayed newborn exam and procedures, etc.) I chose midwives who could be guardians and facilitators of normal birth and, at the same time, be alert for possible
complications and respond appropriately and effectively with treatment, transfer, or transport, as necessary.”

“planning a homebirth...all to avoid any and all unnecessary interventions/drugs/procedures”

“I chose to birth at home so that I would be able to let my body go through the process naturally with a little intervention as possible. I loved that I could move and walk around as much as I wanted...I loved being able to hold my baby right when she was born instead of her being taken away to be cleaned up. I would definitely choose to birth at home again and the only thing I would change would be to try for a water birth next”

The following two participant quotes demonstrate how the mothers wanted to be unhurried and allowed to take the time needed.

“The birth was intense, things happened quickly, but everything always felt unhurried and under control...the midwives let us be alone with her as long as we wanted...She started nursing quickly and easily...The experience was wonderful”

“I’ve had four wonderful homebirths with the same midwife. My labors start very slowly, I’m glad that I’m allowed to take as much time as I need...I have had beautiful and uneventful births with my husband coaching me, and having my beautiful new baby placed directly into my arms”
Follow Instincts as a theme was applied when a respondent stated she experienced or desired the following: a) allowed body to work or takeover, b) to move or position herself as felt right in the moment.

In the following narratives, the mothers describe their bodies taking over.

“I’m going to push and breath and grunt as I please during my labor and delivery and listen to my own body. The next birth went a lot smoother, I was more in control...My husband and his mother assisted me during labor, they stayed quiet and let me do my thing...I walked around my room, swayed my hips, drank and ate as long as I felt like it to keep my strength up (not allowed in hospital) Nobody did any internal checks to tell me how dilated I was. My body told me when to start pushing when it automatically dropped me to the floor and bared down. I delivered in a squatting position...and the baby was delivered into the arms of his grandma and daddy”

“I labored peacefully through the night in my room, bathroom and birth tub...decorated with soft candles and some white christmas lights...I did what my body told me to do, no one else to interfere...I lifted him [the baby] out of the water and we sat there, in awe. Of what I DID. No rushing, no emergencies...Just pure, natural birth...I cherish this memory, the feelings I had, knowing my body did what it was designed to do”

“my 2nd birth experience was absolutely phenomenal. I didn't resist, I opened...my labor and birth were amazing, and physically, a few hours later, I didn't feel like I just had a baby”
**Keep Baby Close** as a theme was applied when a respondent stated she experienced or desired the following: a) baby to stay with mom or a family member and not taken away, b) skin-to-skin contact, c) nursing baby, d) delayed cord clamping.

“I had my baby at home in water just my husband, my daughter and me. It was absolutely wonderful, beautiful, it felt magical. My baby was born very alert, with eyes wide open and right after birth he latched on my breast and he breastfeed for almost 2 hours”

“2nd birth was a home water birth with my wonderful midwife and family present. It was transformative. Absolutely amazing! Breastfeeding and bonding were immediate. We practiced delayed cord clamping and my midwife let me deliver my placenta on my own when it was ready...I also ate and drank throughout my labor which made it much easier. I pushed my son out on my hands and knees in the water...it was amazing”

“I was able to change into lots of positions...My husband caught our baby and we delayed the cord cutting. My baby was beside me for all the newborn checks...We had a lot of skin-to-skin contact”

“my husband and I agreed on a homebirth for our sixth baby, and it was everything we could have asked for in a birth experience – peaceful, no interventions, freedom of movement and eating, delivery in a birth pool, followed by lots of skin-to-skin mommy and baby time and immediate breastfeeding...Everything about it was normal, natural, and wonderful”
“My husband coached me through my entire labor...The midwife was there, but my husband caught the baby and cut the cord after it had stopped pulsating. It was amazing”

The narratives used above represent the individual voices of 32 women who participated in this research. Altogether, 107 narratives were analyzed to generate the six themes. Multiple themes are seen across the quotes, and I chose these quotes and kept the quotes intact because of the strength, emotion, and power they hold. What is described in these quotes is what all childbearers should experience during childbirth, to be respected including the ability to create her own atmosphere, to have autonomy, to follow her instincts, and to keep her baby close, which all ultimately lead to empowerment. To quote Barbara Katz Rothman again: “All of that is missing in the American ‘managed’ birth” (2007:xvi–xvii). Additionally, I want to argue that childbearers having access to this level of care should not be a privilege. Maternal bodies are evolutionary adapted for this level of care; thus, every childbearer should have access to this level of care as a human right.
Study Section B & C: Salivary Cortisol

All samples were assayed for salivary cortisol using a highly sensitive enzyme immunoassay specifically designed for use with saliva (Salimetrics, Irvine, CA). Salivary cortisol units are expressed in µg/dL (micrograms per deciliter). The test uses 25 µL of saliva (for singlet determinations) and has a lower limit of sensitivity of 0.007 µg/dL (range up to 3 µg/dL), and average intra- and interassay coefficients of variation (CVs) of 4.6% and 6.00%, respectively (see Bateup et al. 2002; Hoyt and Granger 2020 for more details on salivary cortisol bioassays).

Eight women collected saliva during their homebirth. All eight women birthed at home with a midwife present. The first four participants (labeled alphabetically) only collected saliva after labor began, peripartum (study section B). The subsequent four participants (labeled numerically) collected saliva antepartum and peripartum (study section C). One participant decided on a hospital birth after complications were discovered and knowledge that the newborn would need immediate medical care upon birth (participant 4). One participant decided to transfer to the hospital after labor became intense. She was admitted to the hospital after her baby was born just outside of the hospital entrance (participant 1).

Antepartum cortisol samples were collected to establish baseline cortisol, in the third trimester, before the participants began early labor. Participants were asked to take up to four saliva samples a day for 4 days. This protocol has two purposes. First, to view the participants’ cortisol awakening response (CAR) & diurnal slope (Figure 4), and second to view the participants early labor measure against an approximate equivalent time of day pre-labor measure (Figure 5).
Each participant’s diurnal profile follows the expected increase from awakening (Mean 0.49) to 30 minutes post awakening (Mean 0.77) to bedtime (Mean 0.30). Data from Jones et al. (2006) is also displayed in the figure for comparison (Figure 4). The average cortisol level was 0.23 in prelabor and 0.37 in early labor with an average increase of 64% between prelabor and early labor (Figure 5).

![Cortisol at awakening and diurnal slope (µg/dL)](image)

Figure 4: Cortisol at awakening and diurnal slope (µg/dL)
Figure 5: Pre-labor vs. early labor cortisol levels at equivalent hours of the day (µg/dL)

Figure 6 displays the cortisol levels of the eight participants from pre-labor, when available, through 12 hours after birth. All eight participants were able to collect four to five saliva samples in the peripartum period. Three of the eight women missed one saliva sample each; however, no women missed more than one sample collection time in the peripartum period. In total, eight women were asked to take 5 peripartum samples each. Therefore, 40 samples were expected and 37 were received leading to 92.5% of samples received and successfully assayed for salivary cortisol. Samples were missed because labor progressed quicker than expected. This was attested to by either the attending midwife or the participant.

The instructions for when to take the first, second, and third saliva samples during the peripartum period were simple and timing of saliva collection depended greatly on the perception of the midwife or participant. The results indicate that exact timing or cervical
dilation, which was used in other studies, is not necessary. For saliva samples four and five in the peripartum period, the instructions were more specific. Sample four was to be taken approximately 30 minutes after delivery, and sample five was to be taken approximately 12 hours after birth.

The mean early labor cortisol was 0.37. As contractions increased cortisol rose to 1.36 and 1.65 as delivery was near. At delivery, cortisol peaked at 3.9 and at approximately 12 hours after delivery cortisol dropped to 0.25 (see Figure 6). This change in cortisol levels is impressive. From early labor to contractions increase there is an average increase of 287% and from early labor to birth there is an average increase of 955%.

Figure 6: Saliva cortisol results from eight multiparous mothers who intended and had a homebirth with a midwife attending (µg/dL)
Figure 7: Maternal cortisol results from eight studies

Maternal salivary cortisol research among homebirth mothers is a new approach to understanding the hormonal physiology of birth. Therefore, it is necessary to compare the results from previous studies to the results obtained by this study. In Figure 7, the results from this study along with seven other studies are presented (Alehagen et al. 2001; Jouppila and Hollmén 1976; Kono et al. 1987; Onur, Erçal, and Karslioglu 1989; Stjernholm et al. 2016; Willcox et al. 1985; Wladimiroff et al. 1983). To be able to compare results between studies the data from previous studies had to be manipulated in the following ways. 1) Cortisol measurements had to be converted to the same units of measurement. All measurement were converted to µg/dL. When the results were presented in pmol/ml or nmol/l, the results were divided by 27.59. When the
results were presented in ng/ml, the results were divided by 10. When the results were presented in umol/l, the results were divided by .002759. 2) Salivary cortisol is a fraction of free plasma cortisol; however, the exact fraction is not a constant. Therefore, converting free plasma cortisol to a salivary cortisol equivalent is an approximation. Here, free plasma cortisol was divided by 0.67 to approximate salivary cortisol. 3) Free cortisol is a fraction of total cortisol, and again, the exact fraction is not a constant; therefore, total cortisol measurements were divided by 0.05 to approximate salivary cortisol (Duplessis et al. 2010; Hindmarsh and Geertsma 2017).

Because each study presented here had different protocols, it is not suggested that the measurement between studies be comparable. What is of interest in comparing between studies is the trajectory of the cortisol profile. Figure 6 demonstrates that the cortisol results from this present study follow a similar trajectory to that of previous studies regardless of whether those studies were conducted using saliva, free plasma cortisol, or total plasma cortisol.

**Study Section C: Anxiety and Fear of Childbirth Levels (Questionnaires)**

Five women completed both the prenatal and postnatal questionnaires. At the time of the first (prenatal) questionnaire, all participants were in their third trimester of pregnancy and were planning for a home birth in the Tampa Bay area of Florida using a local midwife to assist in the birth. The participants were 25 to 35 years old and had one to three previous births. All participants were married and identified as White. One participant also identified as Hispanic. Three participants had previously experienced a hospital birth, and two had only experienced home births. At the time of the second (postnatal) questionnaire, all participants were approximately one month postpartum.
Questionnaires: Wijma Delivery Expectancy/Experience Questionnaire

The average score on the Wijma Delivery Expectancy/Experience Questionnaire (W-DEQ) pretest was 26 with a range of 10 to 38, and the average on the posttest was 55 with a range of 38 to 78. The average increase from the pre- to the posttest was 29 points or 172% increase (Table 1). This indicates that the participants had a greater fear of childbirth after their birth event than before. Fifteen questions showed the greatest intra-individual difference from the pre- to the posttest.

Eight of the thirteen questions with the greatest intra-individual differences related to the following feelings and the participants marked more in agreement (postnatally compared to their prenatal answer) that they had feelings during labor of being lonely, weak, tense, and of feeling panic, hopelessness, pain, and of behaving extremely badly and losing control of herself. Additionally, the remaining seven questions with the greatest intra-individual differences related to the following feelings and the participants marked less in agreement (postnatally compared to their prenatal answer) that they had feelings during labor of being strong, confident, glad, proud, composed, relaxed, and self-confident.

Interestingly, participants did not indicate that they felt more afraid, deserted, desolate, abandoned, or that the situation was dangerous. They also did not vary from the pre- to the posttest on feeling safe, independent, happy, longing for the child, or trust.
Table 1: Wijma Delivery Expectancy/Experience Questionnaire (W-DEQ) Results

<table>
<thead>
<tr>
<th>Participant #</th>
<th>W-DEQ A (pre)</th>
<th>W-DEQ B (post)</th>
<th>Difference</th>
<th>% increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>10</td>
<td>63</td>
<td>53</td>
<td>530</td>
</tr>
<tr>
<td>P2</td>
<td>38</td>
<td>78</td>
<td>40</td>
<td>105</td>
</tr>
<tr>
<td>P3</td>
<td>33</td>
<td>49</td>
<td>16</td>
<td>48</td>
</tr>
<tr>
<td>P5</td>
<td>18</td>
<td>38</td>
<td>20</td>
<td>111</td>
</tr>
<tr>
<td>P6</td>
<td>29</td>
<td>48</td>
<td>19</td>
<td>66</td>
</tr>
<tr>
<td>Average</td>
<td>26</td>
<td>55</td>
<td>29</td>
<td>172</td>
</tr>
<tr>
<td>Median</td>
<td>29</td>
<td>49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min</td>
<td>10</td>
<td>38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max</td>
<td>38</td>
<td>78</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Women equal to or above a sum score of 85 have severe fear of childbirth, and women above a sum score of 100 have clinically fear of childbirth

These results indicate to me that the participants exhibited self-judgment regarding their performance of childbirth, but that they were not disappointed about the support that they received. This finding and topic certainly deserves more research.

**Questionnaires: State-Trait Anxiety Inventory (STAI)**

The State-Anxiety Inventory had an average score of 23.6 on the pretest and 26.8 on the posttest. The Trait-Anxiety Inventory had an average score of 31.6 on the pretest and 32 on the posttest (Table 2). Trait-Anxiety stayed relatively steady, which is as expected. State Anxiety increased by an average of 3.2 points. Four out of the five women expressed a slight increase in state anxiety post-partum compared to in their third trimester of pregnancy. One participant expressed a decrease. An increase in state anxiety follows the trend seen for fear of childbirth.
Table 2: State-Trait Anxiety Inventory (STAI) Results

<table>
<thead>
<tr>
<th>Participant #</th>
<th>STAI (Pretest or 3rd trimester)</th>
<th>STAI (Posttest app. one month postpartum)</th>
<th>Difference</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State Anxiety</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td>20</td>
<td>24</td>
<td>4</td>
<td>20%</td>
</tr>
<tr>
<td>P2</td>
<td>29</td>
<td>22</td>
<td>-7</td>
<td>-24%</td>
</tr>
<tr>
<td>P3</td>
<td>24</td>
<td>32</td>
<td>8</td>
<td>33%</td>
</tr>
<tr>
<td>P5</td>
<td>25</td>
<td>26</td>
<td>1</td>
<td>4%</td>
</tr>
<tr>
<td>P6</td>
<td>20</td>
<td>30</td>
<td>10</td>
<td>50%</td>
</tr>
<tr>
<td><strong>Trait Anxiety</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td>37</td>
<td>35</td>
<td>-2</td>
<td>-5%</td>
</tr>
<tr>
<td>P2</td>
<td>29</td>
<td>34</td>
<td>5</td>
<td>17%</td>
</tr>
<tr>
<td>P3</td>
<td>30</td>
<td>30</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>P5</td>
<td>29</td>
<td>26</td>
<td>-3</td>
<td>-10%</td>
</tr>
<tr>
<td>P6</td>
<td>33</td>
<td>35</td>
<td>2</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Anxiety</td>
<td>23.6</td>
<td>26.8</td>
<td>3.2</td>
<td>13.56%</td>
</tr>
<tr>
<td>Trait Anxiety</td>
<td>31.6</td>
<td>32.0</td>
<td>0.4</td>
<td>1.27%</td>
</tr>
</tbody>
</table>

Gunning et al. (2010) found that the average state anxiety score among women in their third trimester of pregnancy was 36.2 with a standard deviation of 10.5, with average anxiety increasing by approximately 3 points with each trimester. Interestingly, Gunning et al. also found that women attending a community-based clinic (32.7) scored 4.5 points lower compared to a hospital-based clinic (37.2). State anxiety in this research population ranged from 20 to 29 indicating the population had relatively low state anxiety. Trait Anxiety was also lower among this study’s population (31.6) compared to that of Gunning et al.’s Hospital- (37.2) and Community-based population (38.9) in the third trimester, but fell firmly within one standard deviation from the mean.
Figure 8: Average State Anxiety Scores from Gunning et al. (hospital- and community-based data) and this study (home-based data)

Prenatally to postnatally, the study population appears to have had an increase in fear of childbirth and anxiety. The study population is small, and therefore, it is not possible to make conclusions based on the data. However, the finding is interesting and deserves more attention.
CHAPTER 5: DISCUSSION & CONCLUSIONS

The aim of this research is to bring a better understanding to physiologic normal birth by touching on two points. First, what environment is conducive to physiological normal birth? Second, what is the hormonal biology of physiological normal birth, specifically cortisol. In order to address this aim, this study set out to answer four questions: 1) How do non-nulliparous homebirth mothers describe qualitatively in an open-ended format their desired birth experiences, 2) does this qualitative data lend evidence for or against the obligate midwifery hypothesis, 3) can perinatal maternal cortisol be successfully measured in homebirths, a setting that is most typical of where our species delivered babies during most of human evolution, and 4) how does the perinatal maternal cortisol profile during home births compare to the cortisol profile of previous studies conducted in-hospital?

As to the question, how do non-nulliparous homebirth mothers describe, qualitatively in an open-ended format, their desired birth experiences, I found that when women/mothers described positive desirable experiences and circumstances, these desires fell into six themes. The six themes I identified through thematic analysis were as follows: 1) Be Respected; 2) Find Empowerment; 3) Create Atmosphere; 4) Have Autonomy; 5) Follow Instincts; and 6) Keep Baby Close. I believe that when Katz Rothman (2007) described how the American technocratic birth model is failing women in America and the women where this model of birth has been exported, these six themes are the elements that are missing.
The women who offered their birth narratives to this research used the following language to describe their birth experiences: perfect, beautiful, amazing, magical, exhilarating, empowering, bonding, serene, surreal, ecstatic, calm, peaceful, relaxed, unhurried, wonderful, and phenomenal as well as challenging, life altering, painful, powerful, and intense.

The findings from the thematic analysis correspond to previous studies. For example, Fawsitt et al. (2017) conducted focus groups in Ireland. They found a prominent theme in their analysis was ‘Freedom to exercise choice’ with the authors stating that “Women…wanted to be involved in the decision-making during care. Likewise, based on a survey conducted in Ontario, Canada, priorities in the decision-making process among women planning a home birth included the following: birth as a natural process, wanting to avoid interventions, and feeling more comfortable at home. Participants also ‘strongly agreed’ with the statements: I want to be able to move freely in labour; and I want to avoid interventions (Murray-Davis et al. 2014). Further commonalities between studies were revealed in the thematic analysis of the Canada study:

“Thematic analysis of qualitative answers revealed a common belief that hospital birth was riskier due to the higher likelihood of interventions during labour. The women commented on negative aspects of the hospital environment such as lighting, smell, noise, interruptions, and restrictive policies. Other recurring themes were the desire to avoid being on the ‘hospital clock’ during labour as well as the belief that home offered a better environment for postpartum recovery: I want the opportunity to bond with my baby immediately following birth, with people (my midwives) near who appreciate the importance of the bonding experience after birth. Having spent time researching how to meet the needs of my baby, I prefer to have people accessible to me for assistance as needed, yet if possible work from this knowledge I've been gaining to be empowered to care for my baby in the initial hours after birth, uninterrupted by checks, policies, restrictions, and guidance I may not agree with.”
As to the question, does this qualitative data lend evidence for or against the obligate midwifery hypothesis, I found that a birth attendant was present and involved in the birth process when women/mothers described positive desirable experiences and circumstances. These statements fall primarily under the theme ‘Be Respected,’ in which women desired a birth attendant to be present and helpful but also to be given privacy and space when needed. Additionally, regarding the birth attendant, women desired to have autonomy; here, they may be given options but were allowed to make their own decisions without feeling pressured or threatened. Further, women desired to follow their own instincts. Again, this dictates the role of the attendant as someone there to assist but not control the laboring mother. The majority of women desired an attendant as an active participant in labor and delivery. When an experienced attendant was not desired at the birth, the women sought extensive knowledge regarding how to manage birth. Therefore, I find that women’s narratives regarding birth add credence to obligate midwifery. My research adds to the question of obligate midwifery by asking the parturient women themselves what they wanted, by listening to women. My research shows that the parturient women want support.

As to the question, can perinatal maternal cortisol be successfully measured in homebirths, a setting that is most typical of where our species delivered babies during most of human evolution, I found that both midwives and pregnant women were willing to participate and eager to contribute to childbirth research. Further, women were able to take the saliva samples at the times designated, and participants did not find the saliva collection to be a burden. Thus, cortisol research and perhaps other hormonal analyses can be accomplished with homebirth mothers. However, blood contamination is a concern. See appendix B for details on blood contamination.
As to the final question, how does the perinatal maternal cortisol profile during home births compare to the cortisol profile of previous studies conducted in-hospital, I found that the results from this study fell in line with results from other studies. This further validates the use of cotton swabs for saliva collection in childbirth research, a non-invasive method compared to blood collection, whether in-hospital, birth center, or home.

For this research, I utilized multiple materials and methods to answer multiple questions; however, I could have asked one question, how can we better understand the childbirth experience? Through this research, I have concluded that childbirth is an extreme event in the human experience. This can be quantitatively documented using saliva cortisol measures. In no other documented human event does cortisol spike as it does at the point of childbirth. More research is needed to understand how spikes and lows in cortisol impact the progression of labor and mother-infant bonding. Particularly, research is needed on the correlations between cortisol levels and stalled labor, with stalled labor being a catalyst for an emergency cesarean section. Additionally, cortisol spikes during labor and delivery may be correlated with oxytocin release aiding in mother-infant bonding. How does psychosocial stress disrupt this mechanism? I have found, qualitatively, that when a woman’s desires for her childbirth experience and circumstances are met, her stress is reduced and she is more satisfied with her experience. A negative childbirth experience can lead to post-traumatic stress and increase the likeliness of postpartum depression and on the reverse a positive childbirth experience can heal trauma from a previous birth.

Therefore, I recognize the words of Wenda Trevathan, “throughout human evolutionary history, those who sought assistance at birth had more surviving offspring than those who delivered their infants alone. Even a small reduction in mortality and morbidity rates over
hundreds of generations could account for the near-universal practice of accompanied birth we see today. Our ancestors probably sought out others not because of a conscious awareness that it would reduce mortality; instead, it is more likely that they felt anxiety and uncertainty about labor and delivery and sought companionship for emotional support” (2010).

**Future research**

Research already indicates that women who birth out of the hospital setting and women who birth in-hospital but have continuous labor support experience reduced perceived stress and fewer interventions (Sosa et al. 1980; Freeze, 2008; Cheyney, 2014). However, the biological mechanism behind the connection between maternal stress and medical interventions is not understood, and maternal cortisol may be a factor (Benfield et al. 2014; Buckley 2015). This research has demonstrated that saliva can be collected in a non-invasive manner; therefore, more research is needed on maternal cortisol reaction to childbirth and how this may be linked to psychosocial stress induced from the birth environment.

Morse and Park (1988) found that when a birthing system does not consider birth to be a natural event, the women perceived the pain to be more intense than when birth is perceived as a natural event. This phenomenon may be detectable in cortisol levels. One of the triggers to release cortisol is an uncontrolled or unknown circumstance. When women perceive labor pain as unnatural or out of her control, as in the US technocratic example, the stress may elevate her cortisol levels more than in women who perceive the event as natural, as in the Mayan and Dutch examples, or under her control, as in the Swedish example from Jordan (1978).
While the participants in this study were limited, it is expected that women who birth out-of-hospital will perceive labor pain as natural in childbirth and most women who birth in-hospital will perceive labor pain as needing to be controlled by pharmacological means. Testing cortisol levels between these two populations would certainly be insightful regarding labor, stress, cortisol levels, and birth outcomes.

As we saw in the cortisol data, the time of birth is one of the most extreme events the human body will experience. It is especially during this time that assistance is needed by anyone trained in the way of birth. Here titles become non-essential; this person may be a midwife, a doula, a husband/partner, a mother or sister, or friend. When the body is opening, when the cortisol is 500% higher than normal, who can hold space for the birthing woman?

Additionally, in the time of Covid-19, understanding the biological, hormonal mechanisms of birth is critical as women who choose to birth in-hospital are now entering the hospital with more psychosocial stress and are perhaps isolated from loved ones. Alternatively, more women are choosing to birth at home to avoid the hospital altogether.

**Conclusion and recommendations**

The results of this study are important to the fields of anthropology, obstetrics, and midwifery as each field continues to seek a better understanding of physiological normal birth. I conclude that physiological normal birth is best supported when the child-bearer is comfortable in her birth environment. In this we, as humans, are not different from other animals. However, while other animals generally seek isolation during childbirth, humans have adapted to a state of obligate midwifery. Thus, human’s seeking companionship during labor and delivery is a
biocultural adaptation. Seeking companionship is biological rooted and part of our evolutionary legacy. The exact nature and specific social interactions between the child-bearer and the assistant(s) is culturally bound; however, the parturients comfort in her physical environment is critical to the process of physiological normal birth.

Physiological normal birth is an extreme human event, due in part to the hormonal surges required for delivery. This event is best supported by a knowledgeable, caring, and trusted assistant as perceived and selected by the mother. Such assistance should not be a privilege, but a human right.

Limitations & Challenges

Homebirth mothers represent a small percentage of women who give birth in the US. Due to IRB regulations, the PI could not recruit midwives or midwifery practices to recruit and consent participants. Thus due to time constraints, the participant number is small. In future homebirth research involving saliva collection, it would be ideal to have midwives as co-investigators. Further, the participants are homogeneous, and additional research is needed to incorporate the experiences and opinions of diverse populations of childbearers.
REFERENCES


Spielberger, Charles D. 1983. State-Trait Anxiety Inventory for Adults.


APPENDIX A:
INDIVIDUAL CORTISOL, TRANSFERRIN, AND ALPHA-AMYLASE RESULTS

When conducting research using saliva, a concern is blood contamination within the saliva sample. As we saw with blood cortisol vs. salivary cortisol, blood contains a higher amount of cortisol than saliva; therefore, if blood is present in the saliva, cortisol measures may be artificially elevated. Schwartz and Granger (2004) found that transferrin, a protein found in blood at high concentrations but only minimally in saliva, could be used as a surrogate marker for blood contamination. The threshold of greater than 1mg/dl was established as for the contamination level where blood artificially increased cortisol results. However, Granger (2007) notes, “It is noteworthy that while statistically significant, blood contamination explained a relatively small portion of the variance in salivary hormones.” The presence of transferrin was tested for in four participants. It should be noted that no blood was visible in the saliva samples. Among 79 saliva samples collected with these 4 participants, 48 (61%) had transferrin levels above 1 mg/dl. Due to high levels of transferrin, a correspondent at Salimetrics lab suggested that alpha-amylase may be a good alternative to cortisol, as alpha-amylase is not found in blood at high concentrations, and thus blood contamination in salivary samples would not influence the outcome. However, as you will see in figures 6, 8, 10, and 12 below, alpha-amylase does not correlate with the onset of labor or delivery as cortisol does.

I will now present the complete cortisol and transferrin profile of the four participants’ individually.
Participant 2

This participant gave birth within a few days of our original meeting. Therefore, she was unable to connect many saliva samples prior to giving birth and the majority of her non-peripartum cortisol samples were taken post-partum. What is important to note here is that she has a nice circadian rhythm prior to birth, her cortisol spikes 845% at delivery, drops to normal levels at 12 hours after birth, and the circadian rhythm continues. What is not apparent is that transferrin, as a blood contamination surrogate, is having any significant influence on the salivary results. Unfortunately, there was not enough saliva to measure transferrin at the point of ‘Baby is Born’.

What is apparent is that many of her saliva samples are above 1mg/dL; therefore, more research is needed on transferrin in the pregnancy, the peripartum period, and immediately postpartum to evaluate best research protocols with this population.

Figure A1: Maternal cortisol and transferrin results from Participant 2
Participant 3

This participant was able to collect all 21 samples requested. Participants were instructed to take the first sample before arising from bed and to take the second sample 30 minutes later. Additionally, participants were instructed not to brush teeth before saliva samples were collected, but it is interesting that each of the first four spikes in transferrin occur first thing in the morning, which could indicate tooth brushing. Also interesting is that the circadian rhythm of the cortisol profile is well defined and does not appear to be relational to transferrin.
Figure A3: Maternal cortisol and transferrin results from Participant 3

Figure A4: Maternal alpha-amylase results from Participant 3
Participant 5

This participant was able to collect all 21 saliva samples requested. As seen to participant 3, transferrin levels are elevated in the morning. Unfortunately, transferrin at ‘Baby is Born’ was not able to be measured.

Figure A5: Maternal cortisol and transferrin results from Participant 5
Figure A6: Maternal alpha-amylase results from Participant 5
Participant 6

Figure A7: Maternal cortisol and transferrin results from Participant 6

Figure A8: Maternal alpha-amylase results from Participant 6
APPENDIX B:
PRENATAL SALIVA COLLECTION PROTOCOL

Measuring Maternal Psychophysiological Stress during Planned Home Births in the US

Schedule for taking Saliva Samples in your third trimester

Ideally, you will take four saliva samples a day for four days. This will equal a total of 16 saliva samples. Ideally, the samples will be taken over four consecutive days (back-to-back), but if you miss taking a samples just keep going until you have 16 samples. We are trying to measure your baseline cortisol before you go into labor.

You can use the “Normal Diurnal Cortisol (Salivary)” chart as a guide.

Please record the information below when you take your saliva samples.

Day 1: Date__________________

1) Take one sample in the morning when you wake up – Time taken:____________________

2) Take another sample about 30 minutes later – Time taken:________________________

3) Take a third samples either at lunch or dinner – Time taken:________________________

4) Take a final sample before you go to bed– Time taken:_____________________________

Day 2: Date__________________

5) Take one sample in the morning when you wake up – Time taken:____________________

6) Take another sample about 30 minutes later – Time taken:________________________

7) Take a third samples either at lunch or dinner – Time taken:________________________

8) Take a final sample before you go to bed– Time taken:_____________________________
Day 3: Date__________________

9) Take one sample in the morning when you wake up – Time taken:____________________

10) Take another sample about 30 minutes later – Time taken:____________________

11) Take a third samples either at lunch or dinner – Time taken:____________________

12) Take a final sample before you go to bed – Time taken:____________________

Day 4: Date__________________

13) Take one sample in the morning when you wake up – Time taken:____________________

14) Take another sample about 30 minutes later – Time taken:____________________

15) Take a third samples either at lunch or dinner – Time taken:____________________

16) Take a final sample before you go to bed – Time taken:____________________

Please write any notes that you would like to convey to the PI on the back side of this sheet:
APPENDIX C:
PERINATAL SALIVA COLLECTION PROTOCOL

Measuring Maternal Psychophysiological Stress During Planned Home Births in the US

Schedule for taking Saliva Samples:

1) Take one sample in early labor – Date and Time
taken:________________________________________

2) Another sample as you feel labor progresses – Date and Time
taken:________________________________________

3) Take a third sample as you feel delivery is near – Date and Time
taken:________________________________________

Date & Time of
Delivery:________________________________________

4) Take a sample approximately 30 minutes after delivery – Date and Time
taken:________________________________________

5) Take a final sample approximately 12 hours after delivery or the morning following delivery. Date and Time taken________________________________________

Please write any notes that you would like to convey to the PI:

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APPENDIX D:  
IRB APPROVAL FORM

6/12/2017

Nicole Falk Smith  
Anthropology  
81526 Magnolia Complex  
Tampa, FL 33620

RE:  Expedited Approval for Initial Review  
IRB#: Pro00026293  
Title: Measuring Maternal Psychophysiological Stress During Planned Home Births in the US:  
   Phase 1 Pilot Study

Study Approval Period: 6/8/2017 to 6/8/2018

Dear Ms. Falk Smith:

On 6/8/2017, the Institutional Review Board (IRB) reviewed and APPROVED the above  
application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
Protocol for IRB version 2 Measuring Maternal Psychophysiological Stress

Consent/Assent Document(s)*:
Consent form_midwife_SBA Adult Minimal Risk.docx.pdf  
Consent form_pregnant women_SBA Adult Minimal Risk.docx.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the  
"Attachments" tab. Please note, these consent/assent documents are valid until the consent  
document is amended and approved.

It was the determination of the IRB that your study qualified for expedited review which  
includes activities that (1) present no more than minimal risk to human subjects, and (2) involve  
only procedures listed in one or more of the categories outlined below. The IRB may review  
research through the expedited review procedure authorized by 45 CFR 46.110 and 21 CFR  
56.110. The research proposed in this study is categorized under the following expedited review  
category:
(4) Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing.

**Research Involving Pregnant Women or Fetuses (45 CFR §46.204).**
This research involving pregnant women or fetuses meets the requirements for approval per 45 CFR §46.204

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

V Jorgensen MD

E. Verena Jorgensen, M.D., Chairperson
USF Institutional Review Board