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Effects of Human Maternal Placentophagy on Postpartum Maternal Affect, Health, and Recovery

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EFFECTS OF HUMAN MATERNAL PLACENTOPHAGY ON POSTPARTUM MATERNAL AFFECT, HEALTH, AND RECOVERY

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Abstract

Postpartum ingestion of the afterbirth by the mother, or maternal placentophagy, is a common behavior among eutherian mammals, including non-human primates, with humans as a rare exception. Despite the conspicuous absence of placentophagy in the cross-cultural ethnographic record, the practice appears to be gaining popularity among a small but growing number of advocates in various industrialized contexts who claim that the practice provides benefits to the postpartum mother, namely the relief and prevention of postpartum blues and depressive symptoms, improved breast milk production, and enhanced bonding with their infant. Because the placenta serves as an endocrine organ throughout pregnancy and facilitates the exchange of nutrients between mother and fetus, placentophagy supporters suggest that the hormones and nutrients remaining in the placenta after parturition can be used to replenish these substances during the postpartum period, often through the ingestion of dehydrated and encapsulated placenta supplements.

This dissertation addresses the claims of placentophagy advocates through a randomized, double blind, placebo controlled trial in which postpartum women (N=27) were given a supplement containing either their dehydrated and homogenized placenta (n=12), or a similarly prepared placebo (n=15). Questionnaire responses and biological samples were collected during pregnancy and at three postpartum meetings to address whether supplementation with placenta capsules improves postpartum affect, energy and recovery in comparison to a placebo supplement; whether there are differences within and between these two groups in concentration of prolactin, estradiol, and progesterone across meetings and whether these hormones are related to measures of postpartum affect, energy and recovery; and to identify the concentration of

hormones, micronutrients, and environmental metals in dehydrated placenta capsules. The results suggest that participants receiving the placenta supplement experienced a postpartum decrease in depressive symptoms and fatigue that was not experienced by those taking the placebo supplement, but that hormonal differences were not related to these changes. Analysis of the placenta supplements also revealed modest concentrations of some micronutrients and hormones, as well as negligible concentrations of potentially harmful environmental metals.

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Chapter 1: Introduction

Overview of the Topic

The postpartum ingestion of the afterbirth by the mother, or maternal placentophagy, is a common behavior among eutherian mammals, including non-human primates (Kristal, 1980; Soyková-Pachnerová et al., 1954; Stewart, 1977). Of over 4,000 terrestrial mammalian species only camelids (camels, llamas, alpacas, vicunas and guanacos) and humans have been identified as species that do not regularly engage in this behavior (Kristal, 1980; Vaughan & Tibary, 2006).

Despite the conspicuous absence of placentophagy in the cross-cultural record, the practice appears to be gaining popularity among a small but growing number of advocates in various industrialized contexts around the world (Bastien, 2004; Field, 1984; Friess, 2007; Janzsen, 1980; Selander, 2009; Selander et al., 2013; Stein, 2009; Young & Benyshek, 2010). An internet survey of 189 women living in industrialized countries who have engaged in this behavior after at least one birth showed that the overwhelming majority of women in the sample reported experiencing some benefit that they attributed to placentophagy, that their experience with placentophagy was overwhelmingly positive, and that they would ingest their placenta again after subsequent births (Selander et al., 2013). Although participants in this study constitute a self-selected sample, and therefore cannot be generalized to all placentophagic mothers, the results suggest that women who choose to engage in placentophagy do so because they believe it is in some way beneficial, and that most of these women perceive some positive effect as a result of the practice.

Importance of Studying Placentophagy

During gestation, the placenta is responsible for the exchange of nutrients and gases between the mother and fetus, as well as the production and secretion of a number of hormones (Donnelley & Campling, 2008; Gude et al., 2008; Guibourdenche et al., 2009; Taylor & Lebovic, 2007). Research using both experimental animal models and human subjects has suggested that some of these substances are retained by the placenta postpartum and might be bioavailable upon ingestion (Blank & Friesen, 1980; DiPirro & Kristal, 2004; Grota & Eik-Nes, 1967; Kong et al., 2008; Kristal, 1991; Onuguluchi & Ghasi, 1996; Soyková-Pachnerová et al., 1954). This has led some researchers to suggest that placentophagy could provide a means for the mother to replenish hormones and nutrients lost during parturition, and that it may also play a role in improved postpartum recovery and mood (Apari & Rózsa, 2006; Janzsen, 1980; Selander, 2009).

Proponents of placentophagy have adopted these ideas and argue that postpartum placental ingestion is a natural and beneficial part of the birth process and that it plays an important role in preventing or alleviating postpartum depressive symptoms and speeding recovery from childbirth, among other purported benefits (Apari & Rózsa, 2006; Bastien, 2004; Field, 1984; Friess, 2007; Janszen, 1980; Selander, 2009; Selander et al., 2013; Stein, 2009). This support and advocacy of placentophagy as a natural and beneficial practice, seems to have emerged out of the natural birth and natural health movement in the 1960s, where women who were concerned about the risks of unnecessary technological interventions in the birth process began opting for more natural births (e.g. midwife-attended out-of-hospital birth with minimal intervention) (Rooks 1996). Early accounts of placentophagy from this time identify similar birthing choices and express ideas that are aligned with those exhibited by women during the natural birth movement (Ober, 1960; Rooks, 1996).

Although many studies investigating the proximate mechanisms involved in placentophagy have been conducted using experimental rodent models (see Kristal et al., 2012 for a review), research aimed at understanding the physiological and emotional effects of this behavior in humans, and the motivations behind women's decisions to engage in this behavior, have been largely ignored in the scientific literature with the exception of only a few studies (Hammett & McNeile, 1917a; Hammett & McNeile, 1917b; Selander et al., 2013; Soyková-Pachnerová, 1954; Young & Benyshek, 2010). Recently published studies have noted the limited number and limitations of the published literature on this topic, and have called for research that rigorously evaluates the efficacy and safety of the practice (Cole, 2014; Coyle et al., 2015; Marraccini & Gorman, 2015; Selander et al., 2013; Young & Benyshek, 2010; Young et al., 2012).

Although proponents tout the positive effects of placentophagy and attribute a host of benefits to the behavior, the implications of this practice for both maternal and infant health are largely unknown, and women are making the decision to ingest their placenta in the absence of evidence supporting the benefits or exposing the negative effects of placental ingestion. Because placentophagy is a practice that appears to be gaining popularity among mothers in industrialized contexts, evidenced by the increasing media attention the practice has garnered in the last few years in particular (Abrahamian, 2011; Dahl, 2007; Friess, 2007; McLaughlin, 2011; Stein, 2009), it is important to assess not only the benefits claimed by advocates, but also the potential risks of this behavior.

The aim of this dissertation project is to investigate the purported benefits of human placentophagy for postpartum mood and recovery from childbirth among a small number of women participating in this trend. This was done through a double-blind, placebo-controlled trial

in which psychometric questionnaires were administered and biological samples were collected to identify the psychological and physiological effects of ingesting placenta capsules postpartum. Additionally, samples of dehydrated placenta collected from each participant were analyzed to evaluate the hormonal, nutritional, and toxic element composition of placenta capsules in order to address questions about the concentration of beneficial substances in the capsules, as well as concerns about potential accumulation of harmful substances in the organ that may be present in the capsules taken by postpartum mothers. Results from this research are important in understanding the potential physiological, psychological, and emotional consequences of this behavior, and contribute to the placentophagy literature that can be used by postpartum mothers to better inform their decision to engage in placentophagy postpartum.

Overview of the Dissertation

This dissertation is comprised of 7 chapters, the Introduction, Literature Review, Research Questions and Design, Methods, Results, Discussion, and the Conclusion. A brief introduction is provided in the current introductory chapter, which is followed by a more detailed discussion of the topic in Chapter 2, the Literature Review. The Literature Review provides an overview of placentophagy among mammalian mothers, including primates, as well as the history of the practice among human mothers. The physiology and function of the placenta in human gestation is addressed in this chapter, in addition to a discussion of previous research on this topic, in both humans and animal studies, including observational and experimental animal models, in order to frame this dissertation study in the context of the current state of placentophagy research. The chapter concludes with an overview of postpartum maternal health and the role of placentophagy in this topic.

Chapter 3, Study Design and Research Questions, outlines the research questions addressed by the dissertation project. It also provides an overview of the design of the research project in which the methods for the study, described in Chapter 4, are situated. Chapter 4 provides a detailed description of the methodology employed in this research study. This includes information about participant recruitment and inclusion criteria, meeting schedule, data and sample collection procedures, supplement preparation and dosing, and randomization and blinding procedures. The assessment tools utilized in this study are also described in this chapter.

The Results of this study are discussed in Chapter 5. Here I discuss the way the assessment tools were scored and an overview of the statistical methods used is provided. The results presented here include demographic data for participants in both the treatment and control groups, within-subjects and between group comparisons of psychometric variables and hormonal measures, and relationships between psychometric and biological variables. The composition of hormones and environmental metals in dehydrated placenta prepared for encapsulation is reported here, and relationships between biomarkers in the placenta and saliva and plasma samples are addressed. Discussion and interpretation of these results, as well as limitations and recommendations for future placentophagy research are provided in Chapter 6, followed by a summary of the dissertation in the concluding chapter.

Chapter 2: Review of the Literature

Overview of Placentophagy

Maternal placentophagy is the consumption of the afterbirth and birth fluids in mammalian mothers immediately following parturition. Of over 4,000 terrestrial mammalian species (Wilson & Reeder, 2005), humans are among only a handful of species who do not routinely engage in this behavior, and are joined only by camels and their relatives (camelids) (Hrdy, 2009; Kristal, 2009; Vaughn & Tibary, 2006; Young & Benyshek, 2010). The practice of maternal placentophagy among mammals is puzzling for several reasons: among non-human mothers, both the proximate and ultimate causes of the behavior are largely unknown, and conversely, the reason for the conspicuous absence of placentophagy among some mammals, such as humans who do not routinely engage in this behavior, remains unclear. Among non-human mammals, observations indicating a strong desire to consume this organ have been made in rats who more readily give up their pups than the placenta (Kristal, 1991), in macaques who pay more attention to the placenta than the neonate in the first hour after birth (Kemps & Timmermans 1982), and in cows who demonstrate a "violent craving for the placenta" (Soyková-Pachnerová et al., 1954). Although the behavior is ubiquitous among terrestrial mammalian species, including our closest primate relatives, postpartum human maternal placentophagy has not been recorded as a traditional practice in the ethnographic literature (Young & Benyshek, 2010).

Despite its absence among humans, including natural fertility populations, a small but growing number of women, primarily in industrialized countries are ingesting the placenta postpartum in order to reap the many purported benefits of the practice. These include the prevention and relief of postpartum depression, fatigue, and improved lactation, among other

reported positive outcomes (see Selander et al., 2013). Although claims about the benefits that placentophagy provides have never been objectively evaluated, the practice appears to be increasing in popularity. As Selander and colleagues (2013) note, there was a four-fold increase in the reported number of PBi encapsulation clients between 2007 and 2011 and there has been growing media attention given to placentophagy in recent years (Selander et al., 2013).

Mammalian Placental Physiology and Function

Among all eutherian mammals, the placenta is a temporary organ that forms during pregnancy to perform specific support functions for fetal growth. There are three basic types of mammalian placentas demonstrating variation in the degree of invasiveness. From least to most invasive, these are: epitheliochorial, endotheliochorial, and haemochorial. Within each basic type, there is great morphological variation in size, shape, and structure based on the needs and gestation of each species (Loke, 2013). Placental type varies among primates with humans developing a haemochorial placenta, characterized by a discoid shape and deep penetration of the placenta into the uterine wall. In the haemochorial placenta, there is a thin cellular layer between maternal and fetal membranes in the intervillous space where projections from the placenta, called villi, are bathed in maternal blood, and where the exchange of substances between the mother and fetus occurs (Loke, 2013).

The placenta is formed entirely from fetal cells after the fertilized egg implants in the uterine wall (Loke, 2013). After implantation, cells derived from the blastocyst, called trophoblasts, invade the endometrium (uterine lining) and connect with the uterine artery to secure a blood supply. The placenta has two distinct parts, the maternal and fetal sides, which are separated by a very thin layer of cells, the thickness of which decreases across pregnancy, while

placental size and surface area increase (Gude et al., 2008). The exchange of important substances between mother and fetus, such as nutrient and gas exchange from the mother to fetus and the delivery of waste products from the fetus to mother, occurs in the intervillous space. Here, substances cross the placenta in a number of ways: passive diffusion (e.g., oxygen and carbon dioxide), facilitated diffusion with the help of specific transporters (e.g., glucose via GLUT-1 transporter), active diffusion through ion channels operating at a concentration gradient (e.g., many amino acids via sodium ion channels), and osmosis (e.g., water, which after crossing the barrier is ingested into the fetal system from swallowing amniotic fluid) (Donnelly & Campling, 2009). The proper functioning of these mechanisms in the placenta is vital to adequate placental and fetal growth.

The placenta becomes increasingly important across pregnancy in performing many functions necessary for fetal development. It functions as the fetus's lungs, exchanging oxygen and carbon dioxide waste, as the kidneys, filtering and removing waste products from fetal circulation, as the gastrointestinal tract, transferring important nutrients to the fetus, and as an endocrine organ, synthesizing and orchestrating the function production and function of a number of hormones (Donnelly & Campling, 2009; Goodman, 2003; Petraglia et al., 2006). Alterations to placental size, surface area, vascularization, and the thickness of the cell layer between maternal and fetal contact can all impact the interaction between mother and fetus, and in turn, fetal growth and development both positively or negatively (Myatt & Roberts, 2006). Decreased surface area reduces the amount of space available for the blood to pass over, reducing the total amount of substances available for exchange. Reduced vascularization limits the amount of blood flow to the placenta and therefore, the amount of blood that will pass through the intervillous space (Burton et al., 2009). The thickness of the placental barrier limits

the ability of substances to cross the placenta, and as barrier thickness increases, so does the difficulty for certain substances to cross the "placental barrier," reducing availability of the substance to the fetus (Donnelly & Campling, 2009).

The concentration of available transporters also impacts the amount of nutrients that can be transported to the fetus, so that a decreased number of transporters will reduce availability of the nutrient it transports. Thus, disruptions to any of these processes can impair or alter placental and/or fetal growth, and disruption of some of these mechanisms has been identified in cases of intrauterine growth restriction (IUGR) and small for gestational age (SGA) fetuses (Myatt et al., 2006), although animal research also suggests that decreased placental size is sometimes compensated with increased efficiency (Fowden et al., 2008). Placental size and function have also been shown to be altered based on signals from the environment, such as decreased nutrition, increased maternal stress, heat stress, and alterations in oxygen availability (Fowden et al., 2008), and the organ is thought to play a role in fetal programming of characteristics that have been hypothesized to enhance offspring survival to reproduction in stressed or resource poor environments, and which, under more favorable postnatal conditions, may otherwise lead to greater adult morbidity and mortality due to increased susceptibility to cardiometabolic disorders, including cardiovascular disease, type 2 diabetes, hypertension, and coronary heart disease (Myatt et al., 2006; Nellisen et al., 2011). Because the placenta is responsible for so many tasks vital to fetal development, it has the ability to impact lifetime health of the fetus.

Reproductive Endocrine Function of the Human Placenta

The embryo implants in the uterus approximately 8 to 10 days after fertilization and at this time secretes detectable levels of human chorionic gonadotropin (hCG), a hormone that is necessary

in sufficient quantities in order to sustain the pregnancy (Taylor & Lebovic, 2007). During the first trimester, the placenta assumes and coordinates the production of several hormones, some of which are produced at concentrations that far exceed the mother's pre-pregnancy levels, and contribute to some of the symptoms typically associated with pregnancy, such as nausea, mood lability, and fatigue (Petraglia et al., 2006).

By the end of the first trimester, the fetal-placental unit is established, and the fetus begins working with the placenta to control hormone production and secretion, and in the second trimester, concentrations of progesterone and estrogens increase rapidly and continue to climb across pregnancy (Gude et al., 2004; Petraglia et al., 2006; Taylor & Lebovic, 2007). Progesterone is required in order to sustain pregnancy, and is produced by the placenta using maternal cholesterol that is synthesized first into pregnenalone, and then progesterone (Goodman, 2003; Petraglia et al., 2006). This elevated progesterone suppresses both uterine contractions and immune function, with a likely role in preventing maternal rejection of the fetus (Talyor & Lebovic, 2007).

Estrogens are another important steroid hormone whose concentration increases across pregnancy. The placenta produces these hormones from maternal and fetal androgen precursors, primarily fetal DHEA-S which is converted into estriol, and into DHEA, which is then converted to testosterone which is ultimately aromatized to estradiol, and androstenedione which is aromatized to estrone (Petraglia et al., 2006; Taylor & Lebovic, 2007). Maternal concentrations of estrogens increase dramatically across pregnancy, with estradiol and estrone increasing to 50 times higher than pre-pregnancy levels, and estriol (a very weak estrogen) increasing 1000-fold (Taylor & Lebovic, 2007). Maternal androgens also increase during pregnancy, however, these increases are small in comparison to those seen with the female sex steroids, and levels of free

androgens are affected by the presence of sex hormone binding globulin (SHBG) which binds to these hormones rendering them inactive, and by their conversion into estrogens (Taylor & Lebovic, 2007).

Levels of hormones that have been increasing dramatically across pregnancy, such as estrogens and progesterone, plummet with the expulsion of the placenta at birth. Within a few days, both progesterone and estrogen returns to levels experienced in the follicular phase (the phase immediately preceding ovulation) (Taylor & Lebovic, 2007). The dramatic declines in these hormones have been attributed to some of the symptoms experienced by postpartum mothers, namely postpartum blues and depression (Bloch et al., 2000).

Two other hormones, oxytocin, which facilitates uterine contractions, and prolactin, which promotes lactation, play prominent roles in labor and preparation for lactation respectively. Oxytocin increases across pregnancy, and starting at 20 weeks gestation, but especially in the weeks preceding birth, there is growth in the concentration of oxytocin receptors in the uterus as well as increased responsiveness to the hormone (Goodman, 2003; Petraglia et al., 2006; Taylor & Lebovic, 2007). At parturition, oxytocin spikes in response to cervical dilation, and this release of oxytocin leads to increased uterine contraction which further dilates the cervix. This feedback process between oxytocin and cervical dilation continues until the infant and placenta are born (Goodman, 2003). Postpartum, oxytocin stimulates alveolar contractions that facilitate lactation (Goodman, 2003).

Prolactin increases across pregnancy and is responsible (along with estrogen, progesterone, growth hormone, glucocorticoids, and human placental lactogen) for increasing the number and volume of mammary alveoli in preparation for lactation (Goodman, 2003; Taylor & Lebovic, 2007). At the start of labor, prolactin declines at a rate that is influenced greatly by the

presence or absence of breastfeeding. Lactation affects the time it takes for hormones to return to pre-pregnancy levels, and compared to women who do not breastfeed, lactating mothers experience increased levels of both oxytocin and prolactin, which are necessary for milk let-down and production respectively, and return to pre-pregnancy levels more slowly (Goodman, 2003; Petraglia et al., 2006). Prolactin also suppresses the release of gonadotropin releasing hormone (GnRH), which can lead to lactational amenorrhea in breastfeeding women (Taylor & Lebovic, 2007).

Placentophagy in Mammals

Postpartum placentophagy is ubiquitous among eutherian mammalian mothers with few documented exceptions, and the absence of placentophagy has only been noted in a handful of mammalian species, including camelids, humans, and some aquatic mammals (Kristal, 1980; Young & Benyshek, 2010). Several hypotheses have been proposed to explain the ubiquity of this behavior among postpartum mammalian mothers, however, no single explanation is sufficient to explain placentophagy across all mammalian species (Kristal, 1980; Menges, 2007). Kristal (1980) reviews each of the following explanations in detail, providing counterevidence that refutes each argument. One explanation is that placentophagy functions to clean the net site as a means of predator avoidance and disease prevention, however, apex predators, arboreal species, and non-nesting mammals are known to ingest the placenta postpartum. Additionally, the fluids associated with birth would be easily absorbed into the ground at the birthing site and would likely be detected by predators. Another explanation for the behavior suggests that mothers experience a shift toward a carnivorous diet at parturition, however, Kristal's (1973) experimental research with rodents has shown that there is a preference for placenta over other

types of meat. Tinkelpaugh and Hartman (1930) also showed that rhesus macaques that were offered three different types of meat just before and after birth refused all types of meat, and they noted that generally other foods are refused by parturient female monkeys until the placenta has been consumed. A third explanation is that mammalian mothers experience a general hunger at parturition due to decreased food intake prior to birth, however, not all mammals reduce their dietary intake leading up to parturition, as noted in rats by Kristal and Wampler (1973). The final explanation that has been proposed to explain the behavior is that mammalian mothers experience specific hunger for a particular substance that is present in the placenta. This explanation however, does not account for rodents where a large number of virgin females will accept placenta, while some will refuse the organ up to parturition. If the physiological state needed to induce placentophagy in female rodents occurs at parturition, this does not explain placentophagy in virgin female rodents, as the physiological state required to induce this behavior (birth) is not present (Kristal, 1980). Although it is possible that the behavior arose through convergent evolution and each explanation could account for the emergence of placentophagy in different species, there is no *single* hypothesis that explains the behavior across all mammals. For a detailed discussion of these hypotheses and their counterevidence, see Kristal (1980).

Although the proximate and ultimate causes of the behavior among mammals remain unclear, placentophagy has been well-studied in rodents, and physiological effects of the behavior have been identified. Mark Kristal and colleagues at SUNY Buffalo have investigated placentophagy in rats and mice using experimental design to manipulate the behavior. Kristal and colleagues (1980) have identified several factors that influence placentophagy in rodents. They found that although virtually all mice and rats eat the placenta at delivery, nulliparous

females of some strains of mice are more likely to eat the placenta than other strains. Other researchers have investigated placentophagy in rodents and have similarly reported variation in the percentage of virgin individuals who will accept placenta, often noting that peripartum and parous individuals are more likely to be placentophagic. Examples include female Long-Evans rats (*Rattus norvegicus*) (Harding & Lonstein, 2014), biparental California Mouse (*Peromyscus californicus*) females and males (Perea-Rodriguez & Saltzman, 2014), biparental *Phodopus campbelli* dwarf hamster females and males (Gregg & Wynne-Edwards, 2005), and in uniparental Siberian hamster (*Phodopus sungorus*) females and males (Gregg & Wynne-Edwards, 2006). These researchers suggest that placentophagy serves to increase contact between the mother and her neonates, which may enhance postpartum maternal (and, in the case of fathers, paternal) behavior.

Kristal and colleagues (Kristal, 1980) conducted experiments offering placenta to virgin rats during different phases of the estrous cycle and found that they would not eat placenta for the first time during proestrus (the phase immediately before estrus in which estrogen is elevated), indicating an aversion to novel substances during this time (Kristal, 1980). Despite aversions throughout the estrous cycle, Kristal notes that nearly all rats will eat the placenta at birth. Similar work was conducted by Melo and Gonzalez-Mariscal (2003) in rabbits where placenta and liver were offered to animals at different reproductive stages, including estrous, mid-pregnancy, 1 day pre-partum, parturition, 1 day postpartum, and 5 days postpartum, incidence of placentophagy was recorded. None of the rabbits ingested placenta during estrous, and few (less than 14%) accepted placenta during pregnancy or 1 day pre-partum, however, all of the mothers ingested the placenta at birth, and about half accepted donor placenta on days 1 and 5 postpartum. The authors noted that liver was consumed in only about 10% of individuals at

all reproductive stages, and that placenta was ingested sooner and given more attention (i.e.., sniffing) than the liver. The authors conducted a follow-up experiment in the same study in which rabbits were offered placenta at 2 hour intervals leading up to birth, and from 30 minutes to 24 hours postpartum, this time using rabbit pellets as a control instead of liver. Results were reported for tests at 8 hours pre-partum, 2 hours pre-partum, 4 hours postpartum, 6 hours postpartum, and 8 hours postpartum. Again, they found that pre-partum instances of placentophagy were low, while all mothers ingested the placenta at birth. Similarly, the percentage of placentophagic mothers postpartum was high (ranging from 56% - 75% within the first 8 hours postpartum), however, unlike liver, few mothers refused pellets and ingested only placenta (Melo & Gonzalez-Mariscal, 2003).

Because hormonal changes are well-documented as playing a role in the onset of maternal behavior, Kristal (1980) conducted an experiment in which he offered placenta to rats across pregnancy and tracked the percentage of placentophagic individuals each day. He found increased incidence of placentophagy over time, but it never exceeded 50%, and no correlation was identified between hormone levels and the days on which the rats were most likely to accept the placenta for the first time. When Kristal tested the effects of estrogen on placentophagy by administering estrogen in levels sufficient to induce maternal behavior to rats whose reproductive organs had been removed, placentophagy was inhibited (Kristal 1980).

In addition to an influence of reproductive stage and status on willingness to ingest placenta, Kristal and colleagues (Kristal, 1980) noted that rats purchased from a breeding lab had higher rates of virgin (nulliparous) placentophagy than those born and raised in their own lab by about 25-40% (Kristal, 1980). After investigating this observation with a series of tests designed to induce stress in the homegrown rats, they discovered that rats that experienced at least one

stressful event were more likely to be placentophagic as virgins, than rats that had not experienced a stressful event (Kristal, 1980).

Additional work by Kristal and colleagues has also identified an effect of the behavior involving pain reduction. Through a series of experiments in which rats were administered morphine to elevate their pain threshold (as in pregnancy), given either placenta or beef, and then exposed to pain stimuli, Kristal (1991) found that those who ingested placenta showed increased and longer lasting pain tolerance compared to those who ingested beef. This effect was not seen in rats that were not given morphine or in animals administered an opioid antagonist to block the effect of the morphine. These results indicate that while the placenta itself does not induce analgesic effects, it enhances opioid-mediated analgesia, and the substance that elicits this effect, which remains to be identified, has been dubbed "placental opioid enhancing factor" (POEF).

Other experimental rodent data suggests that ingestion of placenta may alter postpartum hormone levels. Two studies conducted in rats indicate that consuming the placenta can affect postpartum concentrations of certain hormones in the serum (Blank & Friesen, 1980; Grota & Eik-Nes, 1967). Blank and Friesen (1980) found that when compared to rats in which placentophagy was prevented, those that ate the placenta had elevated prolactin levels on the first day postpartum and lower progesterone levels on the sixth and eighth days. Grota & Eik-Nes (1967) found that rats that were prevented from consuming the placenta exhibited decreased levels of progesterone on the fourth day of lactation compared to those allowed to consume the organ. Other studies looking at birth in biparental dwarf hamsters in which the father actively assists in the delivery and offspring care, noted that the father joins the mother in consuming the placenta (Gregg & Wynne-Edwards, 2005; Jones & Wynn-Edwards, 2000). This behavior was also investigated in male Siberian hamsters, who do not typically assist or attend births, and

placentophagy was noted only when the father was present during birth (Gregg & Wynne-Edwards, 2006). Harding and Lonstein (2014) examined placentophagy in female rats who were present during the subsequent birth of a sibling litter and found that 58% of these weanling female rats ingested placenta during the birth. Although limited to only a few studies, this research suggests that placentophagy may contain substances that affect certain circulating hormone levels, and parental behavior. Although hormonal analysis was not included in an experimental placentophagy study in rabbits, González-Mariscal and colleagues (1998) found that removal of the placenta and pups from the mother postpartum resulted in decreased lactation compared to rabbits in the control group. This suggests that placentophagy may have positive effects on lactation, which is one of the claims made by advocates of the practice in human mothers (Selander et al., 2013).

Although an evolutionary function of placentophagy among mammalian mothers has not been definitively identified, the presence of this behavior across mammalian species, as well as the enthusiasm with which the organ is consumed, sometimes at the expense of direct interaction with the neonate, suggests that it likely provides a fitness-enhancing benefit.

Placentophagy in Non-Human Primates

Unlike rodents, no experimental research has been conducted that specifically focuses on or manipulates placentophagy in primates, however, observational data on primate placentophagy has been collected in both wild and captive populations of various species, however due to the difficulty of witnessing a wild primate birth, more of these observations are in captive populations. As a result, all of the primate data are limited to observations, with no biological markers recorded and little information regarding specific behavioral differences between

placentophagic and non-placentophagic mothers. As such, these limited data should be interpreted cautiously. For a list of primate species in which placentophagy has been recorded, see Appendix A, Table 2.1 (adapted from Young et al., 2012).

Although placentophagy occurs in all (non-human) primate species, it does not necessarily occur in every individual. For example, prevalence among captive rhesus macaques is about 83%, in baboons the prevalence in about 69%, and the number drops to 25% for chimpanzee. In those mothers that do ingest the placenta, some behavioral effects have been noted. A study with Java macaques reports that mothers pay more attention to the placenta than their newborn in the first hour after birth (Kemps & Timmermans, 1982), suggesting a strong desire to eat the placenta, even during the immediate postpartum period when the mother would be expected to be focused on the neonate. In another study with Java macaques, the author observed an alpha female who took a piece of the placenta from a lower ranking postpartum mother while she was engaged in placentophagy (Ratnayeke & Dittus, 1989). Japanese macaques who ingested placenta postpartum in one study were noted to increase oral behaviors of licking both the neonate, and the mother's own limbs (Negayama et al., 1986), suggesting a relationship between placentophagy and an increase in this maternal licking behavior. Finally, much like the biparental dwarf hamsters, *P. campbelli*, tamarin fathers invest heavily in infant care, and in this species they share the placenta with the mother postpartum, sometimes even including juvenile offspring in the activity (Price, 1990; Pryce et al., 1988).

Placentophagy in Humans

Because humans are an exception among primates in that they do not routinely engage in postpartum maternal placentophagy, our ancestors must have engaged in this behavior in our

evolutionary past, and at some point in prehistory placentophagy was eradicated as a typical behavior in our species. When and why humans stopped practicing placentophagy is unclear, although hypotheses have been suggested ranging from strict cultural explanations of food taboos, to speculation that the behavior may have been dangerous or harmful in our ancestral environment (Young et al., 2012).

The disappearance of placentophagy in humans. One suggested explanation for the absence of placentophagy in humans is that as a substance that is associated with childbirth, an event that is often categorized as "unclean," the placenta is also considered to be "unclean" or even dangerous, and as a result has become taboo as a food in humans (Field, 1984). Davidson (1985) suggested that placenta rituals among humans may function to reduce anxiety through a sense of control over the future health and well-being of the mother, child, and community. This hypothesis is rooted in her observation of the widespread cross-cultural belief that treatment of the placenta can have real effects on the individuals with whom it is closely connected - the child and mother – who are vulnerable during this liminal state. If this is the case, the culturally-appropriate treatment of the postpartum placenta in a ritualistic way would preclude its ingestion, making placentophagy decrease and eventually disappear in humans. The association of placentophagy with cannibalism was discussed by Ober (1979), a medical doctor who noted that the behavior may have been perceived as related to the "uncivilized" practices of human sacrifice and cannibalism, leading to its near-universal cultural rejection. Another explanation for its absence is that placentophagy offers no direct benefits to human mothers who are more likely than mothers of other mammalian species to be adequately nourished at parturition, rendering placentophagy an unnecessary (nutritional) behavior in humans (Friess, 2007).

Other explanations offering an evolutionarily-based argument for the absence of placentophagy in humans have been proposed as well. It is possible that an aversion to placentophagy is the result of a common human avoidance of foods that present visual or olfactory cues signaling the potential for the item to harbor pathogens (*e.g.*, uncooked meat) (Young et al., 2012). It is also possible that placentophagy absence in humans is the result of genetic drift, where the practice would have been neutral in terms of effects on fitness and eventually disappeared as the result of a bottleneck in a small population that gave rise to future human groups (Young et al., 2012).

Given that there are no documented exceptions to the absence of placentophagy among humans until recently, in either contemporary or natural fertility populations, it seems unlikely that any of the proposed explanations can account for the absence of the behavior in our species. Although ideas about "clean" and "unclean" foods and substances are prevalent across cultures, the few universal (or near-universal) taboos such as this that have been identified in humans, are associated with behaviors that impact our fitness (*e.g.*, universal avoidance of feces (Rozin & Fallon, 1987), or incest taboos (Brown, 1991). Although it is possible that placentophagy is a neutral behavioral trait offering no nutritional benefit to well-nourished human mothers, or that the behavior was lost among humans to genetic drift, if this were the case, it is unlikely that the behavior would disappear in every human population, as neutral traits will persist in some individuals (Young et al., 2012).

A 2012 paper proposes that placentophagy disappeared in our species as a result of the uniquely human practice seen in every human culture of the controlled use of fire (Young et al., 2012). The authors suggest that as the use of fire became widespread among human populations, the close contact of human mothers to vegetative fire smoke (VFS) across pregnancy introduced

harmful substances to the mother that may accumulate in the placenta throughout gestation, using cadmium as an example. Because cadmium and other toxic metals are taken up by plants from the soil, when these plants are burned in a fire, these harmful substances are released into the environment and people can be exposed via smoke inhalation and ingestion of fly ash (Faroon et al., 2008; Stefanidou et al., 2008). Based on observational studies in contemporary foraging populations and developing countries where women spend more time in close proximity to fires than do males, it is likely that females in our ancestral environment were exposed to greater quantities of VFS than males (Ezzati, 2001; Lee & Daly, 1999; Marlowe, 2009; von Schirnding, 2001; Wickeramsinghe, 2001). Although many harmful substances that are released in fire smoke cross the placental barrier during pregnancy, some substances, such as cadmium, are unable to pass the barrier and accumulate in the placenta throughout gestation (Clarkson et al., 1985; Iyengar & Rapp, 2001).

If human females were exposed to harmful substances during pregnancy that accumulated in the placenta, it is possible that ingestion of the placenta postpartum could have had negative impacts on the health of the mother, the neonate, or both (Young et al., 2012). Through placentophagy, the mother could have become ill from the effects of acute exposure to the toxic substances in the organ, potentially decreasing survival or ability to care for her newborn in placentophagic women therefore reducing their fitness, or her reproductive fitness could be inhibited through endocrine disruption caused by heavy metal exposure (Henson & Chedrese, 2004; Piasek & Laskey, 1994; Young et al., 2012). The fitness of the newborn may also have been reduced through the ingestion of harmful substances that made their way into the breast milk as a consequence of placentophagy, causing illness in the neonate (Young et al., 2012). This explanation suggests that placentophagy was either a beneficial or neutral behavioral

trait that became maladaptive as a result of our changing environment, and that any benefit placentophagy offered to our ancestors was outweighed by the fitness cost resulting from ingesting the toxin-laden organ postpartum (Young et al., 2012).

Another hypothesis proposed by Kristal and colleagues (2012) offer an adaptive explanation for the disappearance of this behavior in our species. They explain that because a primary benefit of placentophagy in animal models is the effects of POEF for enhancing pain relief following ingestion of placental tissue (and amniotic fluid), the adaptive benefit of not ingesting placenta in human mothers is a *lack* of pain reduction. In humans, they argue, the additional social support and assistance for a parturient female that would be garnered through suppressing placentophagy outweighs the benefit provided by the behavior. This increased social support would translate into strengthened social bonds, transmission of important information related to birth, and additional maternal and neonatal care that would ultimately enhance infant survival (Kristal et al., 2012).

Although the hypotheses that have been proposed to explain the absence of placentophagy in humans are supported by indirect evidence, no experimental research has been conducted to directly evaluate these claims, and these hypotheses remain to be tested.

Placentophagy in the ethnographic literature. Although the belief is held by some that there are human populations who still routinely practice placentophagy, a 2010 review of the ethnographic literature on the behavior, which included a survey of ethnographic works on 179 cultures in the electronic Human Relations Area Files (Yale University) revealed no primary source accounts of maternal placentophagy as a longstanding traditional practice in any culture (Young & Benyshek, 2010). Only one instance of maternal placentophagy was described in this

study. This was an account of the practice in an ethnographic work on the Chicano (Mexican-American) culture in which an Anglo mother attended by a Chicana midwife ingested her roasted placenta following the birth, however this appeared to be consistent with the relatively recent appearance of placentophagy among women in industrialized countries (Keys, 1986).

A handful of accounts of non-maternal placentophagy were identified in which the placenta was given to someone other than the mother as a medicine or remedy for an ailment, or ingested for unidentified reasons. Placenta is administered in Traditional Chinese Medicine to treat a range of ailments and imbalances such as fatigue, infertility, or liver problems, however the recipient is typically not the mother who delivered the organ (Furth, 1999; Shizhen et al., 2003; Yanchi, 1988). Another source indicated that in Vietnamese culture, the placenta is given orally to patients with tuberculosis to aid their recovery (De & Coughlin, 1951). A secondary source also noted that Vietnamese nurses and midwifes of Thai and Chinese descent reportedly ingested the placentas of their patients, however, no additional details were provided (Ober, 1979). Another reported practice was among the Sea Islanders (Gullah) off of the coast of South Carolina, where babies who are born with a caul (described as the placenta covering the face, but typically understood as the amniotic sac covering the face at birth) are given a tea made from their placenta to prevent the ability for them to see spirits (Trott, 2003). A final description of non-maternal placentophagy was included for the Malekula of Oceania, in whom the father of a newborn is alleged to eat a pudding prepared from the placenta and blood of the newborn (Deacon & Wedgewood, 1934), however, this was a secondary account and must be interpreted with caution (Young & Benyshek, 2010). Additional second- and third-hand accounts of both maternal and non-maternal placentophagy have been reported, however they must be considered cautiously as their veracity is unclear. Jacques Gélis (1991) suggests that although humans today

find the placenta repulsive, human placentophagy was at one time widespread and more recently, was practiced by several human populations across the globe. He summarizes several reports of the alleged existence of placentophagy among European populations, starting with early records of the use of placenta by ancient apothecaries to treat ailments such as birth marks, freckles, and tumors. In 17th century France, ingesting placenta was thought to stimulate and support breast milk production, a belief that he states persisted among certain low income Italians until the early 1900s. Accounts from France in the 18th century state that dried placenta was effective in the treatment of epilepsy and internal bleeding. Gélis also notes that the placenta was ingested by Europeans for the aphrodisiac effects of the organ, and to treat infertility. Outside of Europe, maternal placentophagy was reported in 16th century Brazilian mothers, an account that was corroborated by Engelmann in 1881, who claims that Brazilian mothers who birth alone would eat the placenta in secret, and would only burn or bury the organ if under observation by another. He also notes an observation from the 1700s of the Siberian Yakinde in whom the father would cook and eat the placenta with his friends and relatives (Gélis, 1991).

Although it is suggested by some that there are cultures in which this behavior has persisted into the present, studies and accounts of placentophagy in the scientific and anthropological literature have failed to provide a single reliable, first-hand account of the practice in humans outside of the recent postpartum behavior. This suggests that placentophagy does not exist in any contemporary human population as a longstanding traditional practice.

Therapeutic and medical uses of placenta. Besides ingestion of placenta for cultural or therapeutic purposes, the use of placenta in other forms and for other reasons has been noted. The use of placental extracts (both animal and human) is seen in a variety of commercially

available cosmetic and personal care products, including hair care products, lotions, ointments, and skin care products (Donovan et al., 2007; James-Todd et al., 2011; Muralidhar & Panda, 1999; Tiwary, 1998). The use of placenta does not come without concerns, however, as it has been suggested that their use may be linked to the development of reproductive cancers and early onset of secondary sex characteristics in prepubescent females, resulting from exposure to estrogens and progestogens (Donovan et al., 2006; James-Todd et al., 2011; Tiwary, 1998).

Beyond use in cosmetics, placenta and amniotic membranes have also been used in medical treatments, and recently, clinical research using placental tissue and placentally derived cells has increased with the potential for medicinal applications (Silini et al., 2015). Silini and colleagues (2015) provide a comprehensive review of the history and extent of the use of placenta and the amniotic membrane in medicine, including an overview of NIH-registered clinical trials involving these substances or cells derived from them. Amniotic membranes have been used since the early 1900s in the treatment of burns and skin wounds, and their use in this capacity has been found to reduce pain and infection, increase fluid retention, and improve recovery. Other clinical applications of amniotic membranes in the 20th century noted by Silini and colleagues (2015) include use in ophthalmologic treatments, vaginal reconstruction, and surgical procedures. More recently amniotic and placental cells have been isolated and used in treatments for a range of conditions, often with promising results. Examples of conditions being treated with placental or amniotic cells include autoimmune diseases like Crohn's disease and rheumatoid arthritis, burns and skin wounds, ophthalmologic conditions, dental diseases, orthopedic injuries and conditions, pulmonary injuries and diseases, multiple sclerosis, type 2 diabetes, and others (Silini et al., 2015).

The "emergence" of placentophagy in humans. Given that our closest primate relatives engage in placentophagy, some advocates of the practice among humans believe that in avoiding placentophagy, we are ignoring an important part of the birth process, and leaving ourselves vulnerable to postpartum affective disorders and poorer postpartum recovery. Suggestions regarding the potential benefits of placentophagy have been sporadically proposed in the scientific and popular literature since the early twentieth century, and advocacy of the practice began appearing in the scientific literature in the late 1960s and early 1970s (Ober, 1968; Ober, 1973), with enthusiastic support increasing to the present (Apari & Rosza, 2006; Bastien, 2004; Field, 1985; Janszen, 1980; Selander, 2009; Selander et al., 2013; Stein, 2009).

Although no studies explicitly focusing on the motivations for placentophagy have been conducted until recently, the timing and content of the literature regarding placentophagy suggests that ideas about the practice revolved around the appeal of engaging in a "natural" behavior, and that the recent emergence of the behavior in humans may have been influenced by -- or grown out of -- the natural birth and natural food movements (Boucher et al., 2009; Janszen, 1980). The earliest documented account of placentophagy in this context occurred within a communal living situation and was attended by a midwife or lay birth attendant (Ober, 1973), suggesting that the individual practiced a lifestyle and birthing behavior that was counter to the physician-attended hospital birth that was typical at the time (Rooks, 1996). Additional discussion of placentophagy includes claims by supporters that it is a natural part of childbirth and that humans should ingest their placenta since all other mammals do, often suggesting that there are traditional cultures that still practice placentophagy today (Janszen, 1980; Field, 1985). These ideas are consistent with those held by advocates of alternative medicine and the organic and health food movements, who believe that humans are too far removed from our natural state,

and who support health and nutrition related practices that are considered more "natural" and consistent with our pre-industrial roots (Brissett & Lewis, 1978).

Advocates of maternal placentophagy seemingly began by suggesting that the organ provides the mother with a rich source of postpartum nutrients that benefit the recovering mother (Janszen, 1980; Field, 1985), and have since evolved to propose a hormonal mechanism by which the numerous benefits could be provided (Bastien, 2004; Selander, 2009; Selander et al., 2013). In addition to claims that placentophagy is natural and healthful for new mothers, proponents suggest that because the placenta functions as an endocrine organ during pregnancy, exposing the mother to increasing concentrations of hormones across gestation to which she becomes accustomed, and since those hormones are abruptly lost at parturition, the mother experiences hormonal withdrawal that can inflict a host of negative consequences on maternal health, namely postnatal mood lability and depression, and that placentophagy is the body's way of supplementing the mother with the hormones needed until lactation facilitates the resumption of their endogenous production (Apari & Rosza, 2006). Advocates of placentophagy insist that this is not only a natural form of "medicine" but that it is superior to biomedical interventions because the hormonal profile of the placenta is tailored exactly to the body in which it developed.

Despite a lack of evidence that humans have ever engaged in maternal placentophagy as a traditional practice, and virtually no research into the benefit or safety of placentophagy beyond a handful of studies in the early- to mid-20th century (Hammet & McNeile, 1917a; Hammet & McNeile, 1917b; Soykova-Pachnerova et al., 1953), ideas about the benefits of postpartum human placentophagy persist, and the behavior has gained popularity primarily in the United States, Europe, and Mexico (Young & Benyshek, 2010), with a host of reported benefits and

anecdotal support (Bastien, 2004; Field, 1985; Selander, 2009; Stein, 2009). This support and advocacy of placentophagy as a natural practice with health and nutritional benefits, coupled with the rejection of biomedical interventions that are the norm in industrialized countries, has similarities to the natural health/food movement. This movement, which responded to increased concerns about the dangers of biomedical healthcare and questions about where and how our food is produced, is based in similar claims to those of placentophagy advocates that we have strayed too far from natural behaviors, and that optimal health requires less technological intervention and more natural and sustainable practices (Brissett & Lewis, 1978; Davis-Floyd, 1992/2003).

Throughout United States history, midwifery has been available as an option for birth assistance, however, the general attitude toward birthing with a midwife has changed (Rooks, 1996). Research has shown that the demographic profile of women who give birth at home with midwives has changed since the 1960s, where the majority of midwifery clients have traditionally been women of lower socioeconomic status living in rural areas with less access to healthcare, and generally ethnic minorities (Rooks, 1996). A longitudinal study examining the characteristics of midwifery patients found that during the 1990s there was an increase in the number of white, educated women of higher socioeconomic status using midwifery services, and a decrease in the use of midwives by all other ethnic groups, suggesting that these woman are opting for midwife care rather than being forced to use midwives due to limited options (MacDorman & Declercq, 2011). In another study, the reasons given by women for using midwives were primarily safety, followed by the appeal of reducing the use of unnecessary medical intervention. Other top reasons included increased comfort, more control, and better birth outcomes (Lindeman et al., 2009). The anthropological literature on the emergence and

growth of the natural/home birth movement in the US provides context for the appearance and spread of this practice as a natural behavior (see Cheyney, 2010), and it is at this time that the earliest accounts of placentophagy are seen (Ober, 1973), and when similar movements toward more natural child rearing practices, such as breastfeeding, arise (Martucci, 2015).

In addition to increased support for natural childbirth, ideas about food and health have also changed since the 1960s. An increase in the belief that our diets include many foods that are poorly matched with those which our bodies are designed to eat, or that are otherwise harmful (*e.g.*, highly processed or pesticide-laden foods), began during this time, and evidence of these beliefs that have persisted today can be seen in the popularity of books like *Fast Food Nation* and *The Omnivore's Dilemma*, in diets that claim to prescribe ancestrally appropriate foods such as the "Paleolithic" diet, and in the growing popularity of organic foods. These examples illustrate the belief of adherents that foods can have magical and healing properties (Aarnio & Lindeman, 2004; Lindeman et al., 2009), and certain demographics are more likely to adhere to this belief, mainly white women with some college education (Lindeman et al., 2009). Unsurprisingly, the demographic profile of those likely to hold beliefs that food has healing properties is similar to that of the growing population of women opting for midwife-attended home birth, and that of women who reported their experiences with placentophagy in an internet-based survey (Selander et al., 2013). This suggests that some people may be more likely to adhere to a lifestyle that incorporates various aspects of natural health, natural diet, and natural childbirth.

Despite the above noted similarities in the natural health movement and the growing popularity of placentophagy, there are also differences between the two movements. Placentophagy for example, focuses on one specific aspect of the childbirth process, and is often

practiced by women who give birth in hospitals (Selander et al., 2013), suggesting that it may function primarily as an effort to elicit a desired effect, such as the relief or prevention of postpartum depression, which may be independent of an overall belief that natural health or natural birth practices are best.

Human Placentophagy and Postpartum Health and Recovery

Though the practice may have emerged out of the natural health and birth movements, ideas about placentophagy have shifted or expanded to include beliefs that placenta is a natural and beneficial form of maternal "medicine" (Bastien, 2004; Field, 1984; Janszen, 1980). Often the placenta is steamed, dehydrated, pulverized, and encapsulated to be taken as a postpartum supplement in the weeks following parturition, however, various preparation methods are employed ranging from ingestion of raw placental tissue to preparing the placenta in a cooked dish as part of a meal (Bastien, 2004; Janszen, 1980; Selander et al., 2013). Although no data exist to validate the claims of placentophagy advocates, one preliminary study in which women discussed their experience with postpartum placentophagy found that many of the women who had chosen to consume the placenta postpartum had done so because it was "natural", would speed recovery from childbirth, prevent postnatal depression and blues, and improve milk production, among other benefits, and the majority of the women in the study not only reported benefits, but also rated the experience as a positive one that they would repeat after a future pregnancy (Selander et al., 2013).

Postpartum affect. The 2013 survey of women who have engaged in placentophagy after the birth of at least one child suggests that the most common reason for women's decision to ingest

their placenta is to prevent or alleviate postpartum depressive symptoms (Selander et al., 2013). Approximately 80% of women experience postpartum "blues" and 10-15% of women develop postpartum depression (Goeser, 2008). The exact etiology of this condition is unclear, although fluctuating hormone levels and postpartum nutritional deficiencies are suspected by some researchers to play a role in developing depressive symptoms and mood lability during the postnatal period (Apari & Rózsa, 2006; Bloch et al*.,* 2003; Soares & Zitek, 2008). Studies have shown a relationship between low levels of certain hormones or nutrients and increased instance of depression. Evidence from intervention trials also indicates that some symptoms can be alleviated when low levels of hormones and nutrients are replenished. In a 1996 study, Gregoire and colleagues found that administration of estradiol over a 12 week period significantly improved depressive symptoms compared to a placebo in women with postpartum depression. Another study investigating the role of female sex steroids in postpartum depression etiology included women both with and without a history of postpartum depression. For both groups, endogenous gonadal steroid synthesis was suppressed and participants were administered estrogen and progesterone over 8 weeks, simulating pregnancy, followed by an abrupt withdrawal, simulating parturition. The authors found that 63% of women with a history of postpartum depression developed depressive symptoms while none of the controls experienced this change (Bloch et al*.,* 2003).

Other studies have correlated the levels of certain non-steroid hormones with rates of postpartum depression. Prolactin, a hormone involved in breast milk production, has been shown to be lower in women with postpartum depression. Women who breastfeed have lower rates of postpartum depression than those who do not, and because suckling stimulates prolactin production, it has been suggested that this hormone may also have a role in the disorder (Abou-

Saleh et al., 1998). George and Wilson (1983) conducted a study examining endogenous β-endorphin and found that low levels postpartum correlate with depression, anxiety, and tension.

In addition to evidence for a hormonal etiology of postpartum depression, there is some evidence for a relationship between nutrient deficiencies and depressive symptoms as well. Connections have been made between postpartum depression and decreased iron (Beard et al., 2005), and low levels of folate and vitamin B_{12} (Bodnar & Wisner, 2005). Low levels of omega-3 fatty acids have also been correlated with affective disorders (Parker et al., 2006; Rees et al., 2005). For example, Hibbeln (2002) compared seafood consumption, DHA (an omega-3 fatty acid) levels in mothers' milk, and rates of postpartum depression in 23 countries and found that lower seafood consumption and lower breast milk DHA levels were correlated with higher prevalence of postpartum depression. These studies suggest that depleted nutrients postpartum may also be related to the development of postpartum affective disorders.

Because the placenta is known to retain certain hormones and nutrients after its delivery, placentophagy advocates suggest this as the ideal way to restore balance to levels of these substances postpartum and suggest that the behavior functions to stave off postnatal affective disorders, along with a variety of additional benefits. The placenta is known to transfer vitamins (Prasad et al., 1998; Smith et al., 1992), minerals (Smith et al., 1992), trace elements (de Moraes et al., 2011; Lorenzo Alonso et al., 2005; Smith et al., 1992), and other substances necessary for fetal growth such as fatty acids, amino acids, and glucose (Donnelly & Campling 2008; Jones et al., 2007; Prasad et al., 1998). The placenta is also responsible for the synthesis and secretion of a number of hormones across pregnancy such as progesterone, estrogens, androgens, human placental lactogen, human chorionic gonadotropin, placental growth hormone and corticotropin releasing hormone, oxytocin, and relaxin (Di Santo et al., 2003; Gude et al., 2004; Guibordenche

et al., 2009; Hall et al., 1977; Schmidt et al., 1984; Sugahara et al., 1985; Taylor & Lebovic, 2007). Many of these substances have been measured in term human placental tissue, leading some to argue that the placenta is a viable source of hormones and nutrients needed by the recovering postpartum mother. Although questions remain about the ability of these substances to survive the temperatures associated with processing placental tissue to be ingested as a postpartum supplement, a 2000 study (Phuapradit et al.) evaluated the concentration of macronutrients, minerals, amino acids, and hormones in 30 heat dried human placentas (15 female, 15 male) and found detectable concentrations of each substance reported. Of particular interest is the finding that all 4 hormones measured (estradiol, progesterone, testosterone, and growth hormone) were detected in these samples (although growth hormone was not detected in male placentas), as researchers have expressed doubt that hormones in particular would remain after processing (Kristal et al., 2012).

Placentophagy and lactation. In addition to the relief and prevention of postpartum mood lability, placentophagy advocates report a number of other benefits attributed to the behavior, including improved lactation, improved recovery from childbirth and decreased fatigue (Selander, 2009). Despite an abundance of research on the immediate effects of placentophagy in rodent models, only a handful of studies have investigated the effects of placentophagy in human participants, or the use of placenta derivatives to address certain symptoms experienced by human females.

Research in the early 1900's conducted by Hammett and McNeile (1917a; 1917b) suggests that maternal ingestion of dehydrated placenta, given three times daily in 0.6 gram doses, may influence milk quality and infant growth compared to a lack of maternal placenta

supplementation, although these finding are not statistically significant (unpublished analysis of published results, 2013). In 1954, Soyková-Pachnervá et al., published a study in which women who were expected to have difficulty nursing were administered either dehydrated placenta or a dehydrated beef placebo within 2 days postpartum. The authors measured breast milk production and indicators of breast fullness and found that 86% of the women in the group given placenta experienced very good results (determined by increased breast size and milk production) compared to 33% of the women in the control group. These results indicate that placenta may contain substances that assist in improved lactation. This study, however, was not without flaws, as the measures of milk production were rather subjective and the study does not meet the standards of scientific rigor expected of clinical studies today.

Placentophagy and fatigue. One other study using human subjects may provide insight into the health benefits of placenta. Although not focusing on placental ingestion, researchers in Korea conducted a study designed to identify whether Human Placental Extract (HPE) improves symptoms related to menopause (Kong et al*.,* 2008). HPE, sold under the name Laennec, has been commercially available in Japan since the 1950s and is used to treat cirrhosis of the liver. In Korea, it has been available since 2003 and in addition to treating cirrhosis it is used to treat a variety of disorders including liver disease, fatigue and menopausal symptoms. Kong et al., (2008) conducted a single-blind, placebo-controlled trial in which either HPE or a saline placebo was administered subcutaneously to menopausal women across an 8 week span. Well-established menopausal and fatigue scales were used to measure improvements in each area, and the investigation identified statistically significant improvement in the treatment group compared to those who received the placebo, as well as increases in levels of estradiol across the study in the

group receiving HPE. This suggests that the placenta may contain properties that improve fatigue, one of the claims reported by women who have ingested their placentas.

The above research collectively suggests a role for hormonal and nutritional deficiencies in the etiology of postnatal disturbances in affect as well as other complaints typically reported by postpartum mothers. Although ideas about placentophagy initially focused on the behavior as a natural part of childbirth, in recent years, advocates claim more specific health benefits related to the replenishment of these hormones and nutrients through placentophagy and its role in postpartum affect and recovery.

Concerns over Therapeutic Use of Placenta and Maternal Safety

Although placentophagy has increased in popularity since its emergence in the late 1960s/early 1970s, and is touted by proponents as a safe and natural behavior that can positively impact the maternal postpartum experience, the safety of the practice have not been evaluated. While some research has been conducted to evaluate the reported benefits of the practice, as noted previously, these studies are few in number and are not without limitations. Additionally, no research to date has objectively evaluated the safety of human maternal placentophagy.

In light of the lack of research and available information about not only the safety of placentophagy but also its efficacy, in recent studies both placentophagy researchers and medical practitioners have called for scientific investigation of placentophagy that rigorously evaluates the efficacy and safety of the practice (Cole, 2014; Coyle et al., 2015; Kristal et al., 2012; Marraccini & Gorman, 2015; Selander et al., 2013; Young & Benyshek, 2010; Young et al., 2012). In addition to a call for research, concerns have been expressed about the potential risks associated with placentophagy. Because the placenta functions as a barrier between the mother

and fetus during pregnancy, it has been suggested that placentophagy may expose postpartum mothers to environmental contaminants and toxins such as heavy metals (Hayes, 2015; Young et al., 2012; Young et al., 2016), or other environmental pollutants such as pesticides (Young et al., 2012), that have been retained by the organ. Marraccini & Gorman (2015) note that there are some circumstances where placentophagy may be contraindicated, such as cases where the placenta has been affected by meconium or bacterial infection, where mothers smoke, or where cord clamping is delayed. They also raise concerns that in cases where women opt for placentophagy to prevent or treat postpartum conditions, such as depression or nutritional deficiency, that these women may forgo conventional treatment with known efficacy in favor of placentophagy whose effects are unknown. Other concerns that have been raised are that placentophagy may expose the new mother or encapsulation provider to pathogens present in the placental tissue, and the potential for increased risk of the mother developing a thromboembolism as a result of increased estrogen provided by the placenta (Hayes, 2015).

Summary

Given the strong advocacy in support of placentophagy, with a limited amount of available research investigating the benefits of this behavior, it is important to evaluate the claims that proponents have made in support of this growing practice. Additionally, the risks of the behavior remain unknown, with no direct evidence to date to support the safety of this practice for mothers or infants. In order to address these gaps in the literature, this dissertations aims to address whether placentophagy is effective in improving postpartum affect and recovery, whether placentophagy affects postpartum maternal hormone levels, and to identify the hormonal and heavy metal content of dehydrated placenta capsules prepared as a postpartum supplement.

Chapter 3: Research Questions and Study Design

Study Purpose and Aims

As discussed in Chapter 2, the practice of human maternal placentophagy appears to have emerged in recent years among mothers in industrialized countries, despite the absence of the practice as a traditional cultural practice and with little support in the scientific literature for the purported positive effects. While a small amount of data has been collected regarding the physiological and behavioral effects of placentophagy in animals, research on human placentophagy is limited to a handful of experiments in the early and mid-twentieth century, and anecdotal evidence (Bastien, 2004; Field, 1985; Hammet & McNeile, 1917b; Janszen, 1980; Selander, 2009; Stein, 2009; Young & Benyshek, 2010). This lack of attention given to research on placentophagy in the literature is important to address, as the ingestion by a mother of her own dehydrated and encapsulated placenta is a seemingly growing practice that is promoted by advocates of its health benefits (Selander, 2009; Selander et al., 2013).

This strong advocacy for the practice coupled with a limited amount of rigorous scientific research on the topic has led many placentophagy and maternal health researchers to call for research that addresses these claims and evaluates the effects of the practice on maternal postpartum affect and recovery (Cole, 2014; Coyle et al., 2015; Marraccini & Gorman, 2015; Selander et al., 2013; Young & Benyshek, 2010; Young et al., 2012). Additionally, the growing prevalence of the practice combined with a lack of empirical data to evaluate the safety of postpartum placenta supplementation raises questions about the content of both beneficial and potentially harmful substances that might be retained in processed and encapsulated human placenta.

The purpose of this dissertation study is to investigate the widely held beliefs of supporters that placentophagy improves postpartum affect and maternal boding, and that hormones retained by the placenta at parturition may be the mechanism by which these improvements occur. This study also aims to address questions by supporters and skeptics alike regarding the composition of beneficial hormones and nutrients, and potentially harmful environmental metals, in encapsulated placenta supplements, and whether these substances are preserved through the process of steaming and dehydrating the organ in preparation for encapsulation.

Research Design

In order to address this lack of research on human maternal placentophagy, a double-blind placebo-controlled trial was conducted which addresses the questions of whether the postpartum ingestion of a mother's own dehydrated and encapsulated placenta can improve postpartum mood and recovery, whether hormonal or nutritional biomarkers are correlated with postpartum psychometric changes, and to examine the hormonal and nutritional composition of human placenta capsules.

Participants in this study included postpartum women who had decided they would ingest their placenta after birth. Study participants were given either their own dehydrated and encapsulated placenta or a placebo supplement to take during the immediate postpartum period. Biological samples and psychometric data were collected in order to identify whether the women who ingested their placenta experienced positive changes in mood and improved recovery in relation to the control (placebo) group, and whether changes in the concentration of certain

hormones were correlated with any psychological or emotional changes perceived by the participants.

The randomized, double-blind, placebo-controlled design was selected as it provides a way to evaluate the effects of postpartum supplementation with placenta capsules and evaluate whether the claims that there are benefits to placentophagy could be the result of a placebo effect. Because the participants in this study constitute a self-selected sample of women who had already decided to ingest placenta supplements postpartum, they presumably hold some degree of belief that the practice is beneficial at best, and neutral at worst. Given this sample, it is essential to include a control group who receives a placebo supplement in order to ensure that any positive effects experienced by participants in the experimental group include improvements beyond those experienced by participants in the control group. In order to reduce the possibility that the perceived effects of supplementation during the study are influenced by the participants' knowledge of which supplement they are taking, a double-blind, randomized protocol was employed. This ensures that neither the participant nor the research team members who interacted with the participant throughout the study had prior knowledge of the participant's group assignment, and therefore could not consciously or unconsciously influence the perceived effects of the participant throughout the study.

Research Site

All data were collected in Las Vegas, Nevada and surrounding cities in the Las Vegas area (the cities of Henderson and North Las Vegas, Nevada). Human maternal placentophagy has gained popularity among a sizeable group of women in the Las Vegas area, and the city is also home to the internet-based company, Placenta Benefits, LTD (PBi), which provides encapsulation

services, training for providers of this service, and information and resources for postpartum women. These factors make Las Vegas an ideal location to conduct placentophagy research and this facilitated the recruitment of women who were interested in this service.

Research Questions

In order to investigate the purported benefits and physiological effects of placentophagy, whether nutrients and hormones are retained in encapsulated placental tissue, and the potential risks of the practice due to environmental contamination of placenta capsules, this dissertation addresses the following research questions:

1) Does placentophagy, in the form of dehydrated capsules, improve postpartum affect, energy and recovery in comparison to a vegetarian or beef placebo supplement?
2) Are there differences within and between the experimental and control groups (receiving placenta and placebo supplements, respectively) in concentration of salivary and plasma hormones and micronutrients across meetings, and are hormone and micronutrient levels correlated to measures of postpartum affect, energy and recovery?
3) What is the concentration of select hormones, micronutrients, and environmental metals in dehydrated and encapsulated human placenta?

Summary

This dissertation aims to address the limited data and scientific literature on the benefits of placentophagy for postpartum mothers, and answers the call of researchers for rigorous scientific evaluation of the claims of placentophagy supporters. It also aims to identify the hormonal, nutritional, and environmental metal content of processed placenta supplements that have been

steamed, dehydrated, pulverized, and encapsulated for ingestion. The study does this through a randomized, double-blind, placebo-controlled design, which compares the physiological and psychometric effects of placenta capsule supplements in comparison to a placebo supplement. The methods of data collection and analysis are described in detail in Chapter 4.

Chapter 4: Methods

This chapter provides a detailed description of the methodology employed in this research study. This includes information about participant recruitment and inclusion criteria, meeting schedule, data and sample collection procedures, supplement preparation and dosing, and randomization and blinding procedures. The assessment tools utilized in this study are also described here.

Participant Recruitment

One area where placentophagy has flourished among a sizeable group of women is Las Vegas, Nevada. The Las Vegas based organization, Placenta Benefits, LTD (PBi), offers encapsulation services to mothers who wish to ingest their placenta, and provides a source of information and support network for these women (PlacentaBenefits.info). According to Jodi Selander, encapsulation provider and founder of PBi, she processes approximately 120 placentas annually for clients, and over 1,000 women have accessed encapsulation services in the Las Vegas area through her organization alone since 2006, with many who claim to have experienced substantial benefits (personal communication with Jodi Selander, 2016).

Participants were recruited through PBi founder, Jodi Selander, via word of mouth, advertisement on the PBi blog and social networking websites, and through Selander's connections with area midwives and physicians. Additional participants were recruited through word of mouth by women who had previously participated in the study and by midwives and physicians of previous participants.

Healthy women over the age of 18 who were experiencing a normal pregnancy with no anticipated complications, and who had decided to ingest their placenta postpartum were

recruited for this study. Participants were not encouraged to engage in placentophagy during the course of recruitment, and the decision to engage in this behavior was made by all participants prior to enrollment in the study. Women who used drugs or drank alcohol at the time of enrollment, or who smoked cigarettes during pregnancy, were excluded from participating. Participants who had a chronic health condition or who were taking medication during pregnancy were asked to consult their medical practitioner regarding the safety of taking placenta capsules during the postpartum period. In order to participate in the study, they were asked to submit a form indicating that they had consulted their medical practitioner about placentophagy, and that their medical practitioner had not advised them against postpartum placenta supplementation. Participants who met the inclusion criteria for the study scheduled an initial meeting with a team of two research team members during the 36th week of pregnancy where they completed a background questionnaire with screening criteria. Participants who met the screening criteria were enrolled in the study.

Data Collection

A team of two graduate and four undergraduate student researchers assisted the author and co-investigator Laura Gryder in meeting with participants, collecting demographic and psychometric data and biological samples, and entering and reviewing participant data in the study database. All student researchers were trained by the author in the study protocol and completed the required university training, including: Biomedical components of the Collaborative Institutional Training Initiative (CITI) for research with human subjects, Biosafety training, Bloodborne Pathogens training, Chemical Hygiene training, and Department of Transportation Infectious Substance Transportation training (this course was completed only by

research team members who were responsible for sample transportation). Placenta encapsulation was performed by certified encapsulation providers trained in the Placenta Benefits proprietary encapsulation method. Placenta encapsulation providers also completed the Biomedical components of the CITI training program, and were trained for their role in the study protocol by the author. In order to prevent potential participant discomfort and possible effects on hormone measures, all research team members for this study were female.

Participation in the study occurred across four meetings with each participant from late pregnancy to the early postpartum period. Two female research team members were present at each meeting, which included questionnaire administration and biological sample collection. All meetings occurred either in the residence of the participant or at UNLV, at the discretion of the participant. This venue was flexible in order to accommodate the schedule and comfort of the participant. These meetings were typically scheduled to start between 8:00 – 11:00 am, however, in a handful of cases, meetings were scheduled either in the afternoon or evening in order to accommodate unforeseen scheduling constraints of the participant. Morning meetings were scheduled in order to reduce variation in results due to circadian fluctuations in hormonal concentration and the influence of daily events in psychometric questionnaire responses. Although participants were not asked to refrain from these behaviors, the time of last breastfeeding and last contact with the infant were recorded at each postpartum meeting, as these actions are known to elicit hormonal responses in the mother and could affect prolactin measures in this study.

Meeting Schedule

The first meeting occurred during the 36th week of pregnancy. This timeframe was selected in

order to gain a late pregnancy baseline for psychometric and biological measures at a time that also accommodates the somewhat unpredictable timing of birth. A pregnancy measurement is important to collect in order to control for psychometric and biological variables, as pregnancy measures for many variables are related to or can predict many of the postpartum outcomes (*e.g.*, depression, anxiety, attachment, hormonal measures, etc.). At this first meeting, a research team member reviewed the Informed Consent form and answered participant questions. The participant then completed a background questionnaire which collected basic demographic information, reproductive history, and screened for inclusion and exclusion criteria. Participants who met the inclusion criteria were given two questionnaires in order to evaluate a number of psychometric, social, and lifestyle variables. They also provided samples of saliva, urine, and blood at this meeting. Participants were given a copy of the Informed Consent form, and a postpartum resource sheet with information about local and online support groups and organizations.

The second meeting occurred between days 1 and 4 postpartum (within 96 hours of parturition). While a 48 hour postpartum timeframe is ideal for this measure, a 96 hour time window was selected because it allows for a postpartum baseline to be established for psychometric and biological measures while providing flexibility to meet with participants who gave birth in a hospital and had varying timeframes for postpartum release. At this meeting, the two questionnaires given at the initial meeting were administered, the length and weight of the neonate were measured, and samples of saliva, urine, blood, and PBi-processed placenta samples were collected. The placenta was prepared by the encapsulation provider during this early postpartum period and the participant was given a jar of capsules containing either her own dehydrated placenta or a placebo supplement to be taken during the remainder of the study.

Participants were instructed to begin taking their capsules after this meeting so that the data collected at this time was reflective of their baseline postpartum experiences and unaffected by the capsules.

The third meeting occurred between days 5 and 7 postpartum (120-168 hours postpartum). This timeframe was selected to provide an early measure of psychometric and biological markers once capsule supplementation had begun. Research also suggests that postpartum blues and negative affect peak around the fifth day postpartum (Buttner et al., 2015; O'Hara & Wisner, 2014) making this an important point in the postpartum timeline for investigating possible effects of placenta supplementation on postpartum affect. Because the prevention and relief of postpartum depression and blues is the primary benefit claimed by placentophagy advocates (Selander, 2009; Selander et al., 2013), this is an important aspect of postpartum recovery to address in this study, and was considered in the selection for this data collection time-point. At this meeting, the two questionnaires given during the first two meetings were administered, length and weight of the neonate were measured, and samples of saliva, urine, and blood were collected. Additionally, participants were asked to complete the Willett Food Frequency Questionnaire (Willett et al., 1985) in order to evaluate dietary iron intake.

The final meeting was held during the third week postpartum, which for this study, was considered to occur between days 21 and 27 postpartum. This timeframe was selected because the approximate duration of placenta supplementation recommended by Jodi Selander of Placenta Benefit, LTD (personal communication, 2011) is 3 weeks postpartum. Data collected during the third postpartum week provided a final measure of psychometric and biological markers after an extended course of supplementation, representative of a typical recommended duration. At this meeting, the two questionnaires from the previous meetings were administered,

length and weight of the neonate were measured, and samples of saliva, urine, blood, and hair were collected. At the conclusion of the meeting, participants were informed of their group assignment and debriefed, and those who were assigned to the control group were given a jar containing their placenta capsules. For an overview of samples and data collected at each meeting, see Table 4.1.

Questionnaires

The background questionnaire which was administered at the first meeting during pregnancy week 36 was administered to collect demographic information, reproductive history, and to evaluate the screening criteria (see Appendix A). Additionally, information about diet, supplement intake, and medications was collected. Although nutritional supplements and medication use could affect the measures addressed in this study, because many women take prenatal nutritional supplements or medication during pregnancy and postpartum at the recommendation of their health care provider, women who were taking these substances were not excluded from the study, however, information about supplements and medications being taken was recorded at each meeting.

The assessment tools used in this study were selected based on the claims made by placentophagy advocates of the postpartum benefits of the practice (see Selander, 2009; Young & Benyshek, 2010), as well as the most frequently reported perceived effects of postpartum placenta ingestion as reported in a 2013 internet survey (Selander et al., 2013). Potential confounding variables that could impact these measures were also included in the questionnaires (*e.g.*, sleep quality, relationship satisfaction, social support, etc.), and measures were taken

during pregnancy in order to control for the effects of these variables during pregnancy on postpartum measures.

Table 4.1
Data Collected at each Meeting

Time Point	**Biological samples Collected**	**Psychometric Data Collected**
Week 36 Gestation	Blood Saliva Urine	Demographic information Mood Anxiety Stress Sleep quality Fatigue/Energy Marital/relationship satisfaction Maternal-fetal attachment Social Support
96 Hours Postpartum (Supplement administered after data collection)	Blood Saliva Urine Placenta	Demographic information Mood Anxiety Stress Sleep quality Fatigue/Energy Marital/relationship satisfaction Mother-infant bonding Social support Experiences with breastfeeding
Day 5-7 Postpartum (120 – 168 hours postpartum)	Blood Saliva Urine	Demographic information Mood Anxiety Stress Sleep quality Fatigue/Energy Marital/relationship satisfaction Mother-infant bonding Social support Experiences with breastfeeding Experiences with supplement
Week 3 Postpartum	Blood Saliva Urine Hair	Demographic information Mood Anxiety Stress Sleep quality Fatigue/Energy Marital/relationship satisfaction Mother-infant bonding Social support Experiences with breastfeeding Experiences with supplement

Two questionnaires were administered at each participant meeting. One questionnaire was comprised of assessment tools that are available in the published literature and have been previously used in populations of pregnant and postpartum women, as well as additional questions added by the author that were specifically designed to address the study aims. The questionnaires assess mood using the Edinburgh postnatal depression scale (EPDS), a well validated tool for assessing postpartum depression risk (Cox et al., 1987), the Kennerley Blues Questionnaire which evaluates the "baby blues" (Kennerley & Gath, 1989), and the Depression Anxiety Stress Subscale (Lovibond & Lovibond, 1995). Anxiety was assessed using the Depression Anxiety Stress Subscale (Lovibond & Lovibond 1995). Sleep quality was evaluated using the Pittsburgh Sleep Quality Index (Buysse et al., 1989), and fatigue and energy through the Fatigue Assessment Scale (Michielsen et al., 2004). A slightly modified version of the Kansas Marital Satisfaction Scale was included to measure relationship satisfaction (Schumm et al., 1983) (the word "spouse" was modified to "partner" in order to accommodate participants who were in a relationship but not married to their partner). Social support was measured using the Multidimensional Scale of Perceived Social Support which evaluates 3 areas of support: significant other, friends, and family (Zimet et al., 1988). On the questionnaire administered during pregnancy, maternal-fetal attachment was measured using the Prenatal Attachment Inventory (Muller & Mercer, 1993) and during the postpartum meetings, maternal bonding to her infant was measured with the Mother-to-Infant Bonding Scale (Taylor et al., 2005). Additional questions were included in the questionnaires administered at the second, third, and fourth meetings which were designed to evaluate perceived changes in the items commonly identified by placentophagy supporters as being positively affected by the practice, including: energy, anxiety, stress, strength, sleep quality, libido, attachment to the infant, overall health, mood,

breast milk quality and quantity, postpartum bleeding, overall postpartum recovery, and an open-ended question asking if any other changes had been experienced since the last meeting. The questionnaires administered during the third and fourth meetings (the two meetings after supplementation had begun) also asked whether the participant attributed the above changes to the supplement they were receiving during the study, and asked whether they believed they were taking placenta or placebo capsules and asked them to explain why (see Appendices B-D for questionnaires).

The Symptom Checklist-90-Revised (SCL-90R) (Pearson Education, Inc.) was purchased with permission from Pearson Education, Inc. and is composed of 90 questions that ask the participant to rate their level of psychological distress in various categories. It takes approximately 10-15 minutes to complete, measuring nine dimensions of psychiatric symptoms including somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. The SCL-90-R was administered at each meeting in addition to the previously described questionnaire in order to provide a sensitive measure for psychological changes between meetings.

Biological Sample Collection

Samples of blood, saliva, urine, hair and placenta were collected during the course of the study. Saliva, urine and blood were collected at all 4 meetings, placenta samples were collected at the second meeting, and a hair sample was collected at the final meeting. All samples were placed on ice in a cooler immediately upon collection and were transferred to a freezer at UNLV for long-term storage at -40˚C awaiting analysis.

Approximately 2 mL of saliva was collected through unstimulated passive drool into polypropylene cryovials. Participants were asked to refrain from eating a meal or brushing their teeth for 1 hour and from drinking water for 10 minutes prior to saliva collection to prevent contamination and dilution of cortisol in the samples. Where possible, saliva was collected prior to completing the questionnaires and blood sample collection due to the possible effects of stress from responding to sensitive questions and from the finger stick required for the blood draw. Samples were frozen in the cryovials without additives and were stored between1-14 months prior to analysis.

Approximately 20 mL of urine was collected by the participant into sterile urine specimen cups. Urine samples were transferred to polypropylene centrifuge tubes and were stored frozen without additives between 1-14 months prior to analysis.

Approximately 600 µL of whole blood was collected through finger stick capillary blood collection into a polypropylene lithium heparin Multivette collection tube. Samples were centrifuged for 5 minutes at 2,000 x g and 20°C to extract plasma. The plasma was transferred to a microcentrifuge tube and stored frozen without additives between 1-14 months prior to analysis.

Supplement Preparation and Storage

Placebo capsules were prepared by the author at UNLV in accordance with Clark County food preparation standards, and prior to distribution to participants, capsules were stored at -20˚C in a locked freezer at UNLV. Lean organic beef was used to create the meat-based placebo capsules and Quorn brand soy-free vegetarian crumbled beef substitute was used to create the vegetarian placebo capsules. Organic beef was selected due to its visual similarity to placenta and in order

to reduce the potential for the introduction of hormones through the supplement. Quorn brand soy-free vegetarian crumbled beef substitute was selected as the vegetarian option for the placebo capsules due to its visual similarity to placenta, and in order to reduce the potential of introducing phytoestrogens that might be present in soy-based meat alternatives.

Selander or one of her two assistants, Marcie Webb and Romina Lizaso, prepared the placenta capsules for this study in the participants' homes using the Placenta Benefits proprietary procedure and in accordance with OSHA and EPA regulations. In the case of home births, the placenta was refrigerated in the participant's home prior to processing, and for hospital births, the placenta was typically frozen on site and transferred to the participant's home where it was thawed prior to processing. Each placenta was rinsed, stripped of membranes, steamed with a PlacentaBenefits LTD proprietary blend of herbs, dehydrated and pulverized prior to encapsulation. Upon completion of the encapsulation process, the placenta capsules were placed into a jar supplied to the encapsulation provider by the author that was identical to that of the placebo capsules. Capsules that were not immediately given to the participants (*i.e.*, capsules belonging to control group participants) were stored at -20˚C in a locked freezer at UNLV until they were returned to the appropriate participant.

Group Assignment and Blinding Procedures

Group assignment was randomly selected using an internet-based randomization generator and each participant's group assignment was sealed in an envelope labeled with their ID number. Group assignment envelopes were created to accommodate 60 participants prior to the commencement of data collection by the dissertation committee chair who had no role in data

collection or interaction with enrolled study participants, and who retained a master list of all participant group assignments.

In order to ensure that both the participants and research team members were blinded to each participant's group assignment during data collection, once the placenta had been processed the placenta encapsulation provider reviewed the dosage instructions for the capsules with the participant. Once the dosage instructions had been reviewed and the encapsulation provider had answered any questions the participant had, the provider was instructed to privately open a sealed envelope containing the group assignment for the participant, and to leave the appropriate jar of capsules for the participant. Once the group assignment had been revealed to the encapsulation professional, she had no direct contact with the participant thereafter. After the envelope containing the group assignment had been opened, the card listing the assignment was placed into a new envelope labeled with the participant ID number that she then sealed and placed into a Ziploc-type bag with the jar of capsules that was not left for the participant. This jar of capsules was sealed with a label that was marked with a unique alphanumeric ID code that the participant could easily recognize (*i.e.*, the two digit date of her baby's birth, followed by the first two letters of her street name, and ending with the last two digits of her phone number). This was done for easy verification upon return of the placenta capsules to control group participants at the end of the study. The Ziploc-type bag containing the group assignment envelope and jar of capsules was given to the author by the encapsulation provider to be transported to UNLV where it was stored in a locked freezer at -40˚C. For participants in the control group, the jar of their placenta capsules was returned to them at the end of the final meeting following the debriefing.

Dosage Instructions

Dosage instructions were given by a member of the research team during the second meeting, and by the encapsulation professional after the capsules were prepared, and were also written on the supplement jar label. Participants were instructed to ingest two capsules (approximately 550 mg per capsule) three times daily for the first 5 days in which capsules were taken (approximately the first week postpartum), two capsules twice daily from days 6 through 12, and two capsules once daily from days 13 through completion of their participation in the study (approximately day 21). Ingestion of the supplements was the only aspect of their nutritional intake or behavior that participants were asked to alter for the study.

Participant Compensation

At the conclusion of participation, participants were given a gift card of their choice for either Target or Whole Foods in the amount of $80 ($20 per meeting session of participation). Additionally, upon completion of the third meeting, participants were provided with their choice of one of the following services: home cleaning service, meal delivery, or grocery delivery. Placenta encapsulation services were provided free of charge as a part of this study ($250). Participants who withdrew from the study were compensated on a prorated basis that corresponded to the point at which they withdrew. Participants who withdrew after the first meeting were compensated with a $20 gift card, and the participant who withdrew after the third meeting was compensated with a $60 gift card, the service she had chosen at the third meeting, and her placenta capsules were provided to her. The total value of participant compensation was approximately $425 per participant at the conclusion of the study.

IRB Approval and Conflict of Interest

All study procedures were approved by the UNLV Institutional Review Board and the Institutional Biosafety Committee prior to initiation of the project. All participants were recruited through Jodi Selander and word of mouth through her network of local midwives and physicians, and those receiving supplements were limited to women who had already decided to practice placentophagy prior to enrollment in the study. No individuals who had not otherwise decided to ingest their placenta postpartum were asked or encouraged to do so in order to participate in any part of the study. As a placentophagy advocate and encapsulation provider, Jodi Selander's services were employed in recruitment and for placenta encapsulation services, and Selander and her assistants were compensated at the retail rate for encapsulation services. Once the placenta encapsulation provider had been exposed to the group assignment for each participant, they ceased communication with the participant until the conclusion of their participation in the study, at which point, all data for the participant had been collected and her group assignment had been disclosed. Selander had no role in data collection or analysis. Data collection and entry was performed by Sharon Young and Laura Gryder with the assistance of research assistants Tiffany Alvarez, Jacqueline Casey, Elizabeth Chang, Winnie David, Kristen Herlosky, Heidi Manlove, Namritha Manoharan, and Caitlin Roske, and data analysis was performed by Sharon Young and Laura Gryder with the assistance of biostatistics consultant, Chad Cross. None of the research team members involved in the project design, data collection, or data analysis have any personal or financial conflict of interest that may have influenced the outcome of this study.

Data Analysis

Questionnaire scoring. Psychometric questionnaires were scored according to the instructions for each individual assessment instrument that comprised the questionnaire. A

spreadsheet was designed by the author to calculate scores for the individual assessment instruments, and all participant questionnaire responses were entered into this spreadsheet. The formulas in the spreadsheet were checked for errors by co-investigator Laura Gryder, and research assistant Winnie David, and all participant responses that were entered into the spreadsheet were checked for data entry errors by research assistant Kristen Herlosky.

The Willett Food Frequency Questionnaire was scored by Laura Gryder in order to assess iron intake across the year prior to completion of the questionnaire. Participants' dietary iron intake was categorized as either adequate, below the recommended dietary intake, or greater than the recommended dietary intake for pregnant and lactating women, per WHO guidelines. For a detailed description of Willett Food Frequency Questionnaire evaluation in this study, see Gryder, 2015.

Analysis of plasma samples. Plasma samples were shipped overnight on dry ice to ZRT Laboratories (Beaverton, OR) for analysis of prolactin, transferrin, and ferritin using enzyme-linked immunosorbent assay analysis (ELISA).

Analysis of saliva samples. Saliva samples were shipped overnight on dry ice to ZRT Laboratories (Beaverton, OR) for analysis of 17 hormones: 11-deoxycortisol, 17-hydroxyprogesterone, 7-ketodehydroepiandrosterone, aldosterone, allopregnanolone, androstenedione, corticosterone, cortisol, cortisone, dehydroepiandrosterone (DHEA), 5-alpha-dihydrotestosterone (DHT), estradiol, estriol, estrone, melatonin, progesterone, and testosterone using used liquid chromatography tandem-mass spectrometry (LC-MS/MS). For a detailed description of saliva sample analysis, see McHale et al., (2015). Table 4.2 includes the lower

limit of quantification (LLOQ), range, and precision for each salivary anlayte (table courtesy of David Zava and David Kimball, ZRT Laboratory).

Analysis of dehydrated placenta samples. Samples of dehydrated placenta prepared for encapsulation were analyzed to determine the concentrations of hormones, micronutrients, and environmental metals.

Hormonal analysis. Approximately 1000 mg of dehydrated placenta sample from each participant was shipped overnight on dry ice to ZRT Laboratories (Beaverton, OR) for analysis of 17 hormones: 11-deoxycortisol, 17-hydroxyprogesterone, 7-ketodehydroepiandrosterone, aldosterone, allopregnanolone, androstenedione, corticosterone, cortisol, cortisone, DHEA, DHT, estradiol, estriol, estrone, melatonin, progesterone, and testosterone, using LC-MS/MS analysis. Samples of approximately 1000 mg each from 3 different batches of beef placebo and 3 different batches of vegetarian placebo were also shipped on ice to ZRT Laboratories (Beaverton, OR) for analysis. Placebo samples were analyzed using the same procedure as the placenta samples for the 17 hormones listed above using. For a detailed description of placenta and placebo sample analysis methods, see Young et al., (2016a).

Micronutrient and trace element analysis. Approximately 500 mg of dehydrated placenta sample from each participant was further pulverized using a diamonite mortar and pestle and analyzed using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) analysis in the UNLV Geosciences Department Environmental Soil Analysis Laboratory. For a detailed description of the digestion and analysis procedure, see Young et al., (2016b). One sample

Table 4.2
QA measures for salivary analytes

Analyte	**LLOQ**	**Range**	**Precision**
Estrone (pg/mL)	0.4	0.4 - 510	8.7 - 13.7%
Estradiol (pg/mL)	0.2	0.2 – 540	4.3 - 18.7%
Estriol (pg/mL)	0.8	0.8 - 2100	2.9 - 18.9%
Testosterone (pg/mL)	3.0	3.0 - 5100	3.0 - 18.1%
Androstenedione (pg/mL)	5.0	5.0 - 2300	5.2 – 10.9%
DHEA (pg/mL)	20.0	20.0 - 1900	4.1 - 15.2%
DHT (pg/mL)	10.0	10.0 - 920	3.6 - 17.7%
Progesterone (pg/mL)	5.0	5.0 - 10000	4.8 - 10.8%
17OH-Progesterone (pg/mL)	5.0	5.0 - 630	3.9 - 13.8%
11-Deoxycortisol (pg/mL)	5.0	5.0 - 410	6.8 - 16.6%
Cortisol (ng/mL)	0.1	0.1 - 52	5.1 - 17.9%
Cortisone (ng/mL)	0.1	0.1 - 81	4.1 - 14.9%
Corticosterone (pg/mL)	5.0	5.0 - 1800	4.6 - 17.5%
Aldosterone (pg/mL)	10.0	10.0 - 560	8.9 - 18.8%
Melatonin (pg/mL)	2.0	2.0 - 10000	5.2 - 15.9%
7-keto DHEA (pg/mL)	50.0	50 - 4700	6.9 - 19.7%
Allopregnanolone (pg/mL)	10.0	10 - 2500	4.1 – 18.3%

each of approximately 500 mg of beef and vegetarian placebo were also processed and analyzed as described above. Placenta and placebo samples were analyzed to identify concentrations of arsenic (As), cadmium (Cd), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), mercury (Hg), molybdenum (Mo), rubidium (Rb), selenium (Se), strontium (Sr), uranium (U), and zinc (Zn).

Statistical analysis. All statistical analyses were conducted using SPSS version 19 statistical analysis software (IBM). In cases where data points were missing, the value from the participant's previous meeting for that measure was carried forward to fill in the missing value. All continuous data were analyzed using the Shapiro-Wilk statistic, and data that were not normally distributed were log transformed prior to analysis. Demographic variables were compared between groups using a t-test of independence for interval data, or a Chi-Square test of independence for ranked data, to identify differences between the treatment and control groups in these variables.

Scores for selected psychometric assessment tools were analyzed using repeated-measures ANOVA to identify changes both within participants and between the treatment and control groups across the postpartum period. The assessment tools reported here were selected because they represent a subset of the aspects of the postpartum period that are most often claimed by placentophagy advocates to be positively affected by placenta supplementation: postnatal depression, postpartum blues, overall affect, maternal attachment/bonding to the infant, and energy (fatigue). Measures of relationship satisfaction, sleep quality, and social support were also included in this analysis, as they are known to influence mood and affect. An alpha of 0.05 was assumed for all tests.

Concentrations of select hormones were analyzed using repeated-measures ANOVA to identify changes both within participants and between the treatment and control groups across the postpartum period. The hormones addressed here include prolactin, estradiol, progesterone, 17-hydroxyprogesterone, cortisol, testosterone, and melatonin. These analytes were selected based on their relationship to mood disturbances (e.g., sex steroid hormones, prolactin), lactation (e.g., prolactin, progesterone), energy (e.g., estradiol, progesterone), stress (e.g., cortisol), and

other areas of recovery that are claimed by placentophagy advocates to benefit from the practice. Pearson's r correlation analysis was used to identify relationships between these hormones and psychometric measures.

The concentration of 14 environmental metals and micronutrients, and 18 hormones in samples of participants' dehydrated placenta prepared for encapsulation were included in this analysis. Pearson's r correlation analysis was used to identify relationships between the concentration of hormones in the placenta samples and salivary and plasma hormone measures for participants in both the treatment and control groups. With the exception of iron, the environmental metals and micronutrients were not determined in the saliva or plasma samples and therefore, participant measures of these substances were not able to be compared to the concentrations in the placenta samples. The concentration of hormones and environmental metals was also determined in samples of the beef and vegetarian placebo supplements, and these concentrations were compared to salivary measures of these hormones in control participants to identify relationships between placebo supplements and salivary hormone and plasma iron measures.

Chapter 5: Results

Overview

This chapter presents the results of the analyses described in Chapter 4. The chapter begins with an overview of demographic characteristics and reproductive history of the participants in each group, and a comparison of demographic and reproductive differences between groups. The first research question, which addresses whether placentophagy, in the form of dehydrated capsules, improves postpartum affect, energy and recovery, is addressed by comparing changes in psychometric variables across time, and between groups. The second research question, which addresses whether there are differences in salivary and plasma hormone levels within and between participant groups, and whether hormone levels are correlated to changes in postpartum affect, energy and recovery, is addressed by evaluating changes in hormone concentration across time and between groups, and by identifying correlations between biological analytes and psychometric variables. This section also addresses relationships between concentrations of hormones in each participant's dehydrated placenta capsule contents and plasma/salivary measures of the same hormone at each postpartum time point. Finally, the third research question which addresses the concentration of select hormones, micronutrients, and environmental metals in dehydrated and encapsulated human placenta, is answered in this sample by reporting the content of these substances in samples of dehydrated and encapsulated placenta collected from each participant.

Demographic, Reproductive, and Birth Characteristics

Thirty-five women met the inclusion criteria for enrollment in the study and completed the first meeting during the 36th week of pregnancy (16 were assigned to the treatment group, and 19 were assigned to the control group). Of these, nine participants withdrew or were excluded from the study (4 from the treatment group, and 5 from the control group), six after the first meeting (4 treatment group, 2 control group), one after the third meeting (control group), and two after completing the study (control group). In three instances the participant unavailable for the second meeting with the research team; one was released from the hospital more than 96 hours after birth (control group), one participant's placenta was released from the hospital more than 96 hours after birth (treatment group), and one participant's newborn was in the Neonatal Intensive Care Unit and she opted to withdraw from the study to stay with her daughter in the hospital (treatment group). In one instance the placenta was mistakenly discarded by the hospital and therefore unavailable for encapsulation (control group), in another case, the participant withdrew from the study after the first meeting due to feeling overwhelmed after the birth of her child (placenta group), and one participant withdrew from the study after the first meeting for undisclosed reasons (treatment group). The participant who withdrew from the study after the third meeting reported that she did so because she was experiencing mood swings and had concerns about her milk production (control group). Of the two participants who were excluded after completing the study, one was excluded due to receiving both placebo and placenta capsules during the study, making it impossible to evaluate whether her experiences were related to receiving the placenta or placebo supplement control group). The other participant was excluded because she was taking antidepressant medication during pregnancy and throughout the study period (control group). The remaining 26 participants completed the study, and including the participant who withdrew after the third meeting, the total number of participants who are

included in this analysis is 27, with 12 in the treatment (placenta) group and 15 in the control (placebo) group.

The mean participant age during the initial meeting in the 36th week of pregnancy was 29.7 years (SD = 4.39), ranging from 21 to 38 years of age. The majority of women in the sample reported a household income over $50,000 (N = 16, 57.1%), with a median of $50,001 - $60,000 annually (n=15, 55.6%). This is approximately the same as the 2014 median household income in both Clark County, Nevada ($52,070), and the US ($53,482) according to the US Census Bureau (2015). The majority of participants identified as Caucasian (n=22; 78.6%), 4 (14.8%) identified as Hispanic/Latina, and 1 (3.7%) identified as both American Indian/Alaska Native and Caucasian. Twenty-six of the participants (96.3%) reported that they were in a relationship with the father of their child that was born during the course of the study, and one reported that she was friends with the father of her child (3.7%). See table 5.1 for an overview of participant demographic characteristics.

All participants reported taking a nutritional supplement of some type during pregnancy, and 25 (92.6%) reported taking a prenatal or multivitamin. Three (11.1%) participants reported consuming a specialized diet during pregnancy; two vegetarian / mostly vegetarian / vegan, and one mostly vegan and gluten free (a modified “Paleolithic Diet”). Dietary iron intake was evaluated using the Willett Food Frequency Questionnaire, which revealed that all participants were ingesting an adequate amount of dietary iron during pregnancy per the FDA guidelines for pregnant and postpartum women (see Gryder 2015 for a discussion of Willett Food Frequency scoring and analysis).

Table 5.1
Participant Demographic Characteristics

	Treatment Group (N=12)	Control Group (N=15)	Total (N=27)
Mean Age (years)*	32.1 ± 3.40	27.7 ± 4.20	**29.7 ± 4.39**
Education			
Vocational/Technical School	0	1 (6.7%)	**1 (3.7%)**
Some College	4 (33.3%)	7 (46.7%)	**11 (40.7%)**
Bachelor's Degree	5 (41.7%)	3 (20%)	**8 (29.6%)**
Master's Degree	2 (16.7%)	4 (26.7%)	**6 (22.2%)**
Doctoral Degree	1 (8.3%)	0 (0%)	**1 (3.7%)**
Ethnicity	(0%)	(0%)	**(0%)**
American Indian/Alaska Native & Caucasian	0	1 (6.7%)	**1 (3.7%)**
Caucasian	11 (91.7%)	11 (73.3%)	**22 (81.5%)**
Hispanic/Latina	1 (8.3%)	3 (20%)	**4 (14.8%)**
Mean Household Size	2.92 ± 1.31	3.13 ± 1.19	**3.04 ± 1.22**
Annual Household Income			
Declined to state	1 (8.3%)	0 (0%)	**1 (3.7%)**
$20,001 - $30,000	1 (8.3%)	2 (13.3%)	**3 (11.1%)**
$30,001 - $40,000	1 (8.3%)	4 (26.7%)	**5 (18.5%)**
$40,001 - $50,000	0	2 (13.3%)	**2 (7.4%)**
$50,001 - $60,000	1 (8.3%)	2 (13.3%)	**3 (11.1%)**
$60,001 - $70,000	0	2 (13.3%)	**2 (7.4%)**
$70,001 - $80,000	2 (16.7%)	0 (0%)	**2 (7.4%)**
Over $80,000	6 (50%)	3 (20%)	**9 (33.3%)**

Values reported as mean ± SD, or N (percentage of group)
*Statistically significant difference between treatment and control groups ($p < 0.01$)

At the time of enrollment, the majority of participants in this sample were pregnant with their first child (n=15, 55.6%), although only 11 (40.7%) reported that this was their first pregnancy. Six reported one prior live birth (22.2%), 3 reported 2 previous births (11.1%), and 3 reported 3 prior births (11.1%). The mean number of live births for participants in the treatment

group at the time of the study was 1.8 (SD=1.05). See table 5.2 for an overview of participant reproductive and health history.

Most participants gave birth at the hospital (n=21, 77.8%) with either a physician (n=19, 70.4%), a midwife (n=1, 3.7%), or both (n=1, 3.7%), and 6 (22.2%) gave birth at home with a midwife. Two of the participants who gave birth at the hospital with a physician also reported that a doula was present for the birth. Eight participants (29.6%) reported experiencing birth complications, and 18 (66.7%) reported experiencing 1 or more medical interventions during the birth, including induced labor (n=13, 48.1%), pain medication administered (n=11, 40.7%), antibiotics administered (n=4, 14.8%), vacuum suction (n=2, 7.4%), cesarean-section (n=5, 18.5%), other interventions (n=2, 7.4%). Two of the infants born during the study were born on their due date (7.4%), 11 were born before their due date (40.7%), and 14 were born after the due date (50.9%). The mean birth weight for infants born during the study is 125.57 ounces, and the majority of participants reported that they fed their infant exclusively through breastfeeding (n=21, 77.8%), while 6 (22.2%) reported a mixture of breast- and bottle-feeding, some noting that when they bottle fed, the infant was fed breast milk. See table 5.3 for an overview of characteristics of the births that occurred during the study.

Table 5.2
Participant Reproductive and Health History

	Treatment Group (N=12)	Control Group (N=15)	Total (N=27)
Parity			
Mean number of live births	1.9 ± 1.24	1.4 ± 0.90	**1.8 ± 1.05**
One Live Birth	7 (58.3%)	8 (53.3%)	**15 (55.6%)**
Two Live Births	1 (8.3%)	6 (40%)	**7 (25.9%)**
Three Live Births	2 (16.7%)	1 (6.7%)	**3 (11.1%)**
Four Live Births	2 (16.7%)	1 (6.7%)	**3 (11.1%)**
Planned Pregnancy			
Yes	7 (58.3%)	10 (66.7%)	**17 (63%)**
No	5 (41.7%)	5 (33.3%)	**10 (37%)**
Feelings Toward Pregnancy			
Very Unhappy	1 (8.3%)	0	**1 (3.7%)**
Somewhat Unhappy	0	0	**0**
Neither Happy nor Unhappy	2 (16.7%)	0	**2 (7.4%)**
Somewhat Happy	3 (25%)	6 (40%)	**9 (33.3%)**
Very Happy	6 (50%)	9 (60%)	**15 (55.6%)**
Previous Depression			
Did not experience condition	9 (75%)	11 (73.3%)	**20 (74.1%)**
Mild	1 (8.3%)	1 (6.7%)	**1 (3.7%)**
Moderate	2 (16.7%)	3 (20%)	**3 (11.1%)**
Previous Maternity Blues			
Did not experience condition	11 (91.7%)	12 (80%)	**23 (85.2%)**
Mild	0	1 (6.7%)	**1 (3.7%)**
Moderate	1 (8.3%)	2 (13.3%)	**2 (7.4%)**
Previous PMDD			
Did not experience condition	12 (100%)	14 (93.3%)	**26 (96.3%)**
Mild	0	1 (6.7%)	**1 (3.7%)**
Previous Postnatal Depression			
Did not experience condition	10 (83.3%)	15 (100%)	**25 (92.6%)**
Mild	0	0	**0**
Moderate	2 (16.7%)	0	**2 (7.4%)**
Previous Antenatal Depression			
Did not experience condition	10 (83.3%)	13 (86.7%)	**23 (85.2%)**
Mild	0	2 (13.3%)	**2 (7.4%)**
Moderate	2 (16.7%)	0	**2 (7.4%)**
Special Dietary Practice			
Vegan/Vegetarian/Mostly Vegetarian	1 (8.3%)	1 (6.7%)	**2 (7.4%)**
Gluten Free/"Paleolithic" Diet	1 (8.3%)	0	**1 (3.7%)**
No Specialized Diet	10 (83.3%)	14 (93.3%)	**24 (88.9%)**
Prenatal Supplements			
Prenatal or multivitamin	12 (100%)	13 (86.7%)	**25 (92.6%)**
Iron supplement	2 (16.7%)	2 (13.3%)	**4 (14.8%)**
Other vitamin, mineral, or herbal supplements	5 (41.7%)	4 (26.7%)	**9 (33.3%)**
Prenatal Medications			
Yes	5 (41.7%)	6 (40%)	**11 (40.7%)**
No	7 (58.3%)	9 (60%)	**16 (59.3%)**

Values reported as mean ± SD, or N (percentage of group)
No statistically significant difference between treatment and control groups were found for birth characteristics

Table 5.3
Information about the birth experienced during the study

	Treatment Group (N=12)	Control Group (N=15)	Total (N=27)
Birth Location			
Hospital with a physician	8 (66.7%)	11 (73.3%)	**19 (70.4%)**
Hospital with a midwife	0	1 (6.7%)	**1 (3.7%)**
Hospital with a physician & midwife	0	1 (6.7%)	**1 (3.7%)**
Home with a midwife	4 (33.3%)	2 (13.3%)	**6 (22.2%)**
Birth Complications			
Yes	4 (33.3%)	4 (26.7%)	**8 (29.6%)**
No	8 (66.7%)	11 (73.3%)	**19 (70.4%)**
Medical Interventions			
Induced labor	4 (33.3%)	9 (60%)	**13 (48.1%)**
Pain medication administered	4 (33.3%)	7 (46.7%)	**11 (40.7%)**
Antibiotics administered	1 (8.3%)	3 (20%)	**4 (14.8%)**
Vacuum suction	2 (16.7%)	0 (0%)	**2 (7.4%)**
Cesarean-section	3 (25%)	2 (13.3%)	**5 (18.5%)**
Other interventions	1 (8.3%)	1 (6.7%)	**2 (7.4%)**
Days from Due Date			
Number born on due date	1 (8.3%)	1 (6.7%)	**2 (7.4%)**
Number born before due date	6 (50%)	5 (33.3%)	**11 (40.7%)**
Number born after due date	5 (41.7%)	9 (60%)	**14 (51.9%)**
Mean number of days from due date	-2.0 ± 7.6	0.67 ± 8.5	**-0.63 ± 8.0**
Mean number of days early	7.5 ± 6.4	8.6 ± 7.8	**8.0 ± 6.7**
Mean number of days late	4.2 ± 3.4	5.6 ± 3.6	**5.1 ± 3.4**
Mean Birth Weight (ounces)	126.50 ± 18.41	124.83 ± 16.25	**125.57 ± 16.92**
Feeding Method			
Breastfeeding only	9 (75%)	12 (80%)	**21 (77.8%)**
Breast- and bottle-feeding	3 (25%)	3 (20%)	**6 (22.2%)**

Values reported as mean ± SD, or N (percentage of group)
No statistically significant difference between treatment and control groups were found for birth characteristics

Demographic, reproductive, and birth characteristics for treatment group participants. Twelve participants (44.4% of the sample) were randomly assigned to the treatment group which received their own dehydrated and encapsulated placenta as a postpartum supplement. The mean age of participants in the treatment group during the 36th week of pregnancy was 32.1 years (SD = 3.40), ranging from 26 to 37 years of age. The median income range for participants in the treatment group was over $80,000, and half of the women in this group reported a household income over $80,000 (n=6). Of the remaining 6 participants in this group, 2 (16.7%) reported an annual income between $70,001 - $80,001 (8.3%) reported between $50,001 - $60,000, 1 (8.3%) reported between $30,001 - $40,000, 1 (8.3%) reported between $20,001 - $30,000, and 1 (8.3%) did not report her annual household income. The median income of women in the treatment group of over $80,000 annually is higher than the 2014 median household income in both Clark County, Nevada ($52,070), and the US ($53,482) according to the US Census Bureau (2015). All but 1 participant in the treatment group identified as Caucasian (n=11; 91.7%), and 1 (8.3%) identified as Hispanic/Latina.

At the time of enrollment, the majority of participants in this group were pregnant with their first child (n=7, 58.3%). One woman reported one prior live birth (8.3%), 2 reported 2 previous births (16.7%), and 2 reported 3 prior births (16.7%). The mean number of live births for participants in the treatment group at the time of the study was 1.9 (SD=1.24). Seven (58.3%) participants reported that the current pregnancy was planned, and 5 (41.7%) reported that the pregnancy was not planned. The majority of participants in the treatment group reported that they were happy when they learned they were pregnant (n=9, 75.0%), o2 (16.7%) reported that they were neither happy nor unhappy, and 1 (8.3%) reported that she was very unhappy to learn about her pregnancy.

Most participants in this group gave birth at the hospital with a physician (n=8, 66.7%), and 4 (33.3%) gave birth at home with a midwife. Two of the participants who gave birth at the hospital with a physician also reported that a doula was present for the birth. One third of the participants in the treatment group (n=4) reported experiencing birth complications, and 7 (58.3%) reported one or more medical interventions during the birth. These included administration of antibiotics (n=1, 8.3%) and pain medication (n=4, 33.3%), induced labor (n=4, 33.3%), vacuum suctioning (n=2, 16.7%), cesarean section (n=3, 25.0%), or another intervention (n=1, 8.3%).

Demographic, reproductive, and birth characteristics for control group participants. Fifteen participants (55.6% of the sample) were randomly assigned to the control group which received capsules containing dehydrated and encapsulated beef or vegetarian meat substitute as a postpartum placebo supplement. Twelve (80.0%) participants received the beef placebo capsules, and 3 (20.0%) received the vegetarian placebo capsules. The mean participant age during the 36th week of pregnancy was 27.7 years (SD = 4.39), ranging from 21 to 38 years of age. The majority of women in the control group reported an annual household income of $50,000 or less (n=8, 53.5%), with a median of $40,001 - $50,000 annually. This is lower than 2014 median household income in both Clark County, Nevada ($52,070), and the US ($53,482) according to the US Census Bureau (2015). The majority of participants in the control group identified as Caucasian (n=11; 73.3%), 3 (20.0%) identified as Hispanic/Latina, and 1 (6.7%) identified as both American Indian/Alaska Native and Caucasian.

At the time of enrollment, just over half of participants in the control group were pregnant with their first child (n=8, 53.3%). Five reported one prior live birth (33.3%), 1 reported

2 previous births (6.7%), and 1 reported 3 prior births (6.7%). The mean number of live births for participants in the control group at the time of the study was 1.67 (SD=0.90). Two thirds (n=10) of the control group participants reported that the current pregnancy was planned, and 5 (33.3%) reported that the pregnancy was not planned. All participants in the control group reported that they were happy when they learned they were pregnant, with 6 (40.0%) reporting that they were somewhat happy, and 9 (60.0%) reporting that they were very happy.

Most participants gave birth at the hospital (n=13, 86.7%) with either a physician (n=11, 66.7%), a midwife (n=1, 6.7%), or both (n=1, 6.7%), and 2 (13.3%) gave birth at home with a midwife. About one fourth of the participants in the control group (n=4, 26.7%) reported experiencing birth complications, and 11 (73.3%) reported one or more medical interventions during the birth. These included administration of antibiotics (n=3, 20.0%) and pain medication (n=7, 46.7%), induced labor (n=9, 60.0%), cesarean section (n=2, 13.3%), or another intervention (n=1, 6.7%).

Demographic and reproductive differences between groups. Between-group differences in education, ethnicity, and annual household income were evaluated using a Chi-Square test of independence, which revealed no significant difference between the treatment and control groups in education (X^2 (4, N = 27) = 3.697, p =.449), ethnicity (X^2 (42, N = 27) = 1.687, p =.430), or income (X^2 (6, N = 27) = 9.066, p =.170). An independent t-test was used to evaluate between group differences in age and household size, and revealed no significant differences between groups in household size (t=-0.450; df=25; p=0.657), however, there was a significant difference between groups for age (t=2.904; df=25; p=.008). Women in the treatment group were significantly older than participants in the control group.

Between-group differences in characteristics of the participants' reproductive and health histories were evaluated using a Chi-Square test of independence. Analysis revealed no significant differences between groups in whether the pregnancy was planned (X^2 (1, N = 27) = 0.199, p = 0.656), their feelings about the pregnancy (X^2 (3, N = 27) = 4.320, p = 0.229), history of depression (X^2 (2, N = 27) = 0.068, p = 0.967), maternity blues (X^2 (2, N = 27) = 1.057, p = 0.590), premenstrual dysphoric disorder (PMDD) (X^2 (1, N = 27) = 0.831, p = 0.382), postnatal depression (X^2 (1, N = 27) = 2.700, p = 0.100), antenatal (pregnancy) depression (X^2 (2, N = 27) = 4.109, p = 0.128), special dietary practices (X^2 (2, N = 27) = 1.350, p = 0.509), and whether they took supplements during pregnancy (X^2 (1, N = 27) = 0.142, p = 0.706). An independent t-test was used to evaluate between group differences in parity, and revealed no significant differences between groups (t=0.607; df=25; p= 0.549).

Between-group differences in birth location, birth complications, medical interventions, and feeding method were evaluated using a Chi-Square test of independence, which revealed no significant difference between the treatment and control groups in any measures (birth location, X^2 (3, N = 27) = 2.842, p = 0.417; birth complicaitons, X^2 (1, N = 27) = 0.142, p = 0.706; medical interventions, X^2 (1, N = 27) = 0.675, p = 0.411; feeding method, X^2 (1, N = 27) = 0.096, p = 0.756). An independent t-test was used to evaluate between group differences in gestational age and birth weight, and revealed no significant differences between groups in either measure (gestational age, t = -0.851; df = 25; p = 0.403; birth weight, t = 0.250; df = 25; p = 0.805).

Research Question 1

The first research question addresses whether placentophagy, in the form of dehydrated capsules, improves postpartum affect, energy and recovery. Repeated measures ANOVA

analysis was performed for measures of depressive symptoms, fatigue, maternal-infant bonding, and infant weight, in order to identify differences between groups in these measures, as well as changes in these measures across the 3 postpartum meetings. Missing values were replaced with the mean value of the group for the particular measure and time point for which the data point was missing (e.g., a missing depression score at the second postpartum meeting for a treatment group participant would have been replaced with the mean depression score of treatment group participants at the second postpartum meeting). Data that did not meet the normality assumption were log-transformed prior to repeated measures ANOVA analysis. Data that did not meet the normality assumption after log transformation were rank transformed prior to repeated measures ANOVA analysis. These variables were selected to evaluate 4 of the most commonly claimed benefits of placentophagy: relief or prevention of postpartum depressive symptoms, improved energy/decreased fatigue, improved maternal bonding with the infant, and increased breast milk production and/or quality.

Postpartum depressive symptoms: Edinburgh Postnatal Depression Scale. In order to evaluate whether placentophagy, in the form of dehydrated capsules, improves postpartum affect, specifically postpartum depressive symptoms, data from the Edinburgh Postnatal Depression Scale (EPDS, Cox et al., 1987), administered across the study, were analyzed. Differences in postpartum depression score within-subjects and between groups was evaluated using repeated-measures ANOVA across the three postpartum meetings. Several variables that are known predictors of postpartum depression were included in the model, including postpartum depressive symptoms during pregnancy (EPDS score during pregnancy), stress and anxiety during pregnancy (DASS21, Stress and Anxiety scores), social support (mean overall MSPSS score),

history of depression (self-reported), history of postpartum depression (self-reported), parity (self-reported), birth complications (self-reported), presence of breastfeeding (self-reported), and whether a C-section was performed (self-reported). Because scores on the DASS21 and MSPSS were not normally distributed, scores for all continuous variables were rank transformed prior to repeated-measures ANOVA analysis. Between-subjects analysis revealed no significant difference between groups in any control variables, therefore all control variables were removed, and the analysis was repeated on log transformed EPDS scores.

Mauchly's test indicated that the sphericity assumption had been violated ($X^2(2) = 7.536$, $p = 0.023$), so the Greenhouse-Geisser correction was applied ($\varepsilon = 0.788$). Within-subjects analysis showed that there was not a significant main effect of time across the three postpartum meetings ($F(2, 27) = 2.693$, $p = 0.092$), indicating that EPDS score did not change significantly over time for both groups combined. There was, however, a significant interaction of time and condition (placebo vs. placenta) ($F(2, 27) = 4.022$, $p = 0.034$), indicating that depression scores for each group are changing over time in different ways. Bonferroni corrected post hoc tests show there were no statistically significant differences between meetings in EPDS score measures in the control group (postpartum meeting 1 to 2, $p = 1.000$; postpartum meeting 1 to 3, $p = 0.500$; postpartum meeting 2 to 3, $p = 0.909$), however, there was a significant decrease in depressive symptoms in the treatment group between postpartum meetings 1 and 2 ($p = 0.012$), but not between meetings 1 and 3 ($p = 0.270$), or 2 and 3 ($p = 1.000$). This means that participants receiving the placenta supplement experienced a decrease in depressive symptoms, as measured by EPDS score, from the first postpartum meeting (pre-supplementation) to the second postpartum meeting (post-supplementation), that did not occur in the control group. Between-subjects tests indicate that the variable condition was not significant ($F(1, 27) = 1.469$,

$p = 0.237$), indicating that overall, EPDS scores were the same for both groups when time is not considered. (See Figure 5.1).

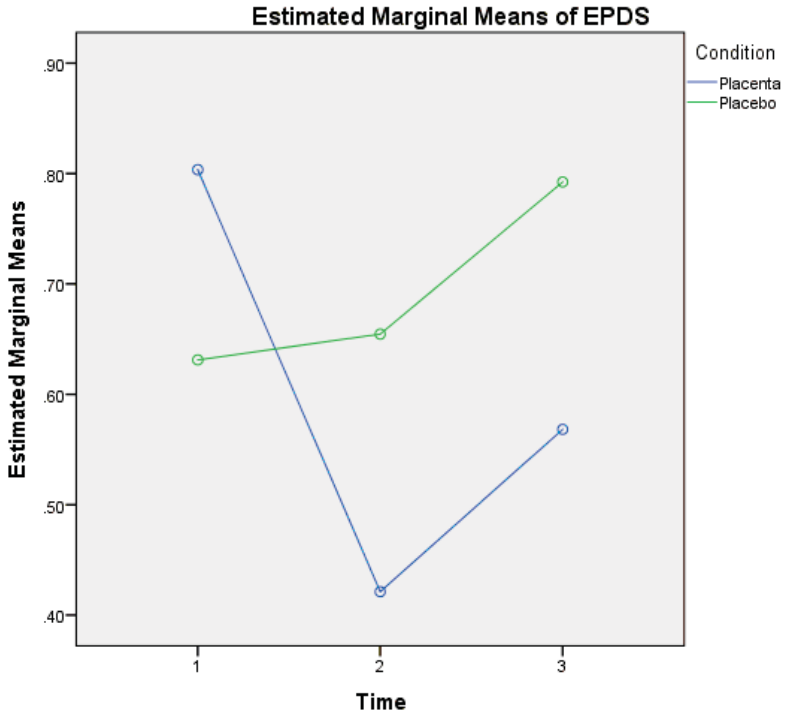

Figure 5.1. EPDS score estimated marginal means across postpartum meetings by condition.

Energy: Fatigue Assessment Scale. Energy was evaluated using the Fatigue Assessment Scale (FAS) scale (Michielsen et al., 2004). Differences in FAS score within and between groups were evaluated using repeated-measures ANOVA across the three postpartum meetings with age, fatigue during pregnancy (FAS score during pregnancy), and sleep quality (PSQI overall score) included in the model because they could affect postpartum fatigue scores. Because scores on the FAS were not normally distributed, these scores were log10 transformed prior to repeated measures ANOVA analysis. Between-subjects analysis revealed no significant difference

between groups in the age and pregnancy fatigue control variables, therefore these 2 variables were removed, and the analysis was repeated with log10 transformed FAS scores, controlling for sleep quality.

Within-subjects analysis showed that there was not a significant main effect of time across the three postpartum meetings ($F(2, 27) = 1.336$, $p = 0.272$), indicating that FAS score did not change significantly over time for both groups combined. There was, however, a significant interaction of time and condition ($F(2, 27) = 4.473$, $p = 0.017$), indicating that FAS scores changed over time for each group in different ways. Pairwise comparisons using the Bonferroni adjustment indicated that mean FAS score for both groups combined did not change significantly between any of the 3 postpartum meetings ($p = 1.000$). A one-way ANCOVA was conducted to identify between group differences in FAS score, controlling for sleep quality, at each individual postpartum meeting and revealed that the mean FAS score at the final postpartum meeting was significantly lower in the treatment group than in the control group ($F(1, 24) = 5.788$, $p = 0.024$). Between-subjects tests indicate that the control variable PSQI score was significantly related to FAS score ($F(1, 27) = 26.877$, $p < 0.001$). Analysis also revealed that the variable condition was not significant ($F(1, 27) = 0.003$, $p = 0.958$), indicating that overall, FAS scores were the same for both groups when time is not considered. (See Figure 5.2).

Bonding and attachment: Mother-to-Infant Bonding Scale. Postpartum maternal bonding was evaluated using the Mother-to-infant Bonding (MIB) scale (Taylor et al., 2005). Differences in MIB score within-subjects and between groups were evaluated using repeated-measures ANOVA across the three postpartum meetings, including as control variables prenatal attachment (Prenatal Attachment Inventory, or PAI, score), social support (mean MSPSS score

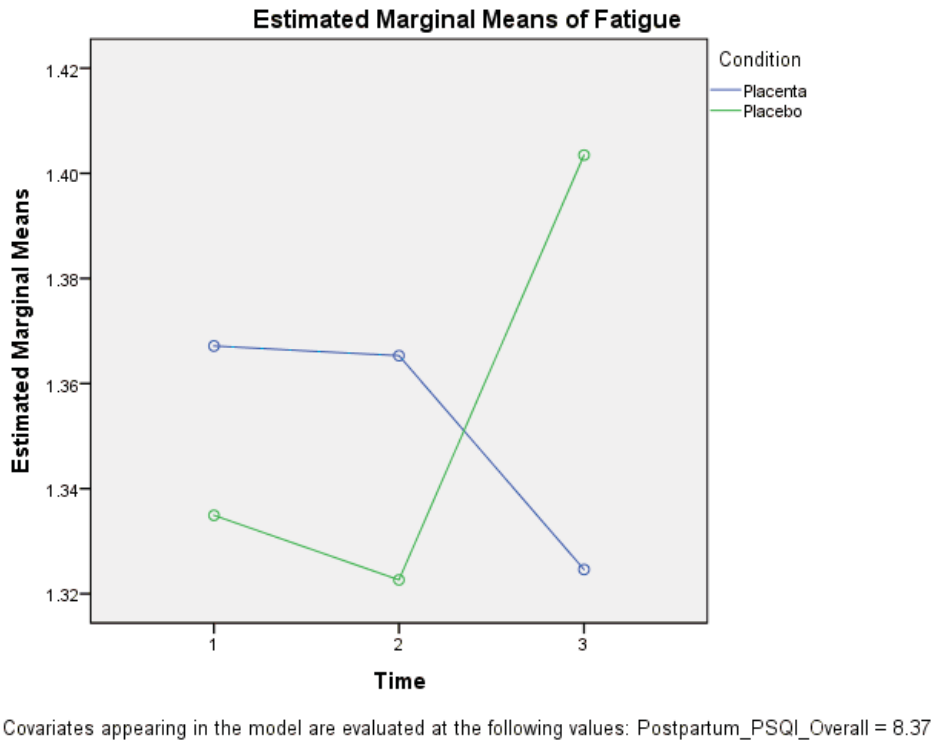

Figure 5.2 FAS score across postpartum meetings by condition

during pregnancy and postpartum), birth complications (self-reported), presence of breastfeeding (self-reported), and whether a C-section was performed (self-reported). Because scores on the MIB and MSPSS were not normally distributed, scores for all continuous variables were rank transformed prior to repeated measures ANOVA analysis. Between-subjects analysis revealed no significant difference between groups in any control variables except prenatal attachment, therefore all other control variables were removed, and the analysis was repeated on log10 transformed MIB scores, controlling for PAI score during pregnancy.

Within-subjects analysis showed that there was not a significant main effect of time across the three postpartum meetings ($F(2, 27) = 1.488$, $p = 0.236$), indicating that MIB score did not change significantly over time for both groups combined. There also was not a significant interaction of time and condition ($F(2, 27) = 4.652$, $p = 0.202$), indicating that MIB score did not

differ significantly between groups over time. Between-subjects tests show that the control variable PAI score is significantly related to MIB score ($F(1, 27) = 26.877$, $p < 0.001$), and that the variable condition is not significant ($F(1, 27) = 2.095$, $p = 0.161$), indicating that, overall, MIB scores were the same for both groups when time is not considered. A one-way ANCOVA was conducted to identify between group differences in MIB score, controlling for attachment score during pregnancy, at each individual postpartum meeting and revealed that the mean MIB score at the final postpartum meeting was significantly lower in the treatment group than in the control group ($F(1, 24) = 5.666$, $p = 0.026$), indicating higher maternal bonding in the treatment group than the control group at this time point. (See Figure 5.3).

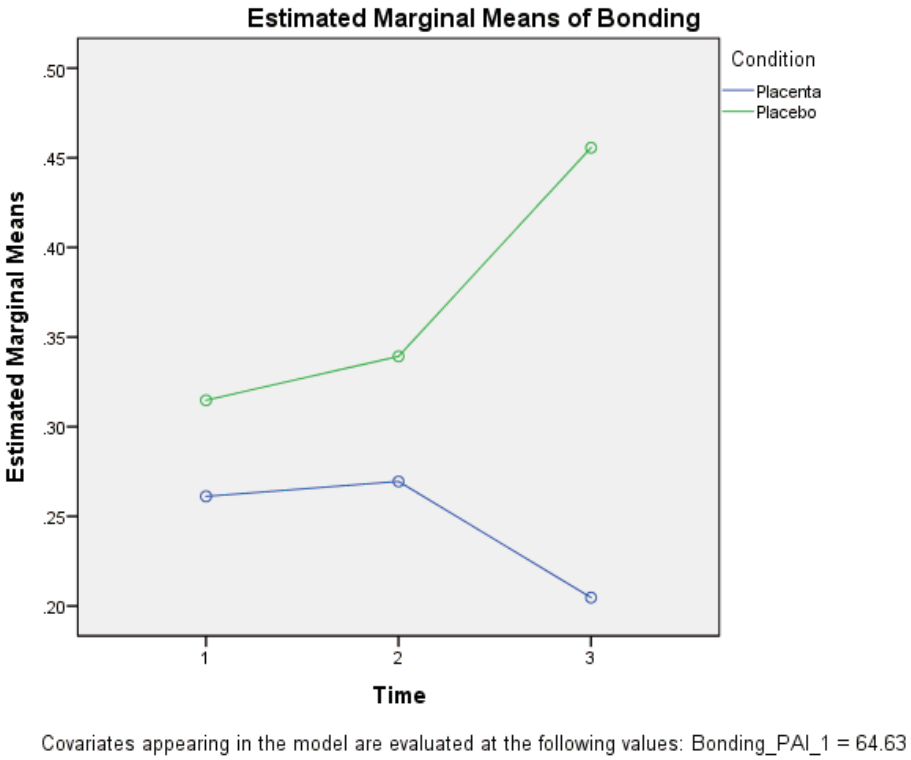

Figure 5.3 MIB score across postpartum meetings by condition (note that a higher score indicates lower bonding)

Infant weight. Because breast milk was not collected and production was not measured directly during this study, in order to address the claim that placentophagy increases breast milk production, infant birth weight was collected, and weights were taken at each of the 3 postpartum meetings as an indirect measure of breast milk quantity/quality. Difference in infant weight within and between groups was evaluated using repeated-measures ANOVA across the three postpartum meetings. Several variables that could influence infant weight were included in the model. These are: infant birth weight (reported by participant), whether the infant was breastfed or bottle and breastfed (self-reported), maternal height (self-reported), maternal weight (self-reported and collected), number of days born before or after the due date (self-reported), whether there were complications during the birth (self-reported), parity (self-reported), and depressive symptoms (EPDS). Between-subjects analysis revealed no significant difference between groups in infant feeding method, maternal weight, number of days born from the due date, whether there were birth complications, and depressive symptoms, therefore these control variables were removed, and the analysis was repeated for infant weight, controlling for birth weight, maternal height, and parity.

Mauchly's test indicated that the sphericity assumption had been violated ($X^2(2) = 11.347$, $p = 0.003$), therefore the Greenhouse-Geisser correction was applied ($\varepsilon = 0.713$). Within-subjects analysis showed that there was not a significant main effect of time across the three postpartum meetings ($F(2, 27) = 0.015$, $p = 0.956$), indicating that time is not a significant predictor of infant weight for both groups combined. There also was not a significant interaction of time and condition ($F(2, 27) = 0.441$, $p = 0.581$), indicating that infant weight did not differ significantly between groups over time. Between-subjects tests indicate that the control variables birth weight ($F(1, 27) = 217.350$, $p < 0.001$) and maternal height ($F(1, 27) = 4.962$, $p = 0.036$),

are both significantly related to infant weight. Analysis also revealed that the variable condition is not significant ($F(1, 27) = 2.729$, $p = 0.112$), indicating that overall, infant weights were the same for both groups when time is not considered. (See Figure 5.4).

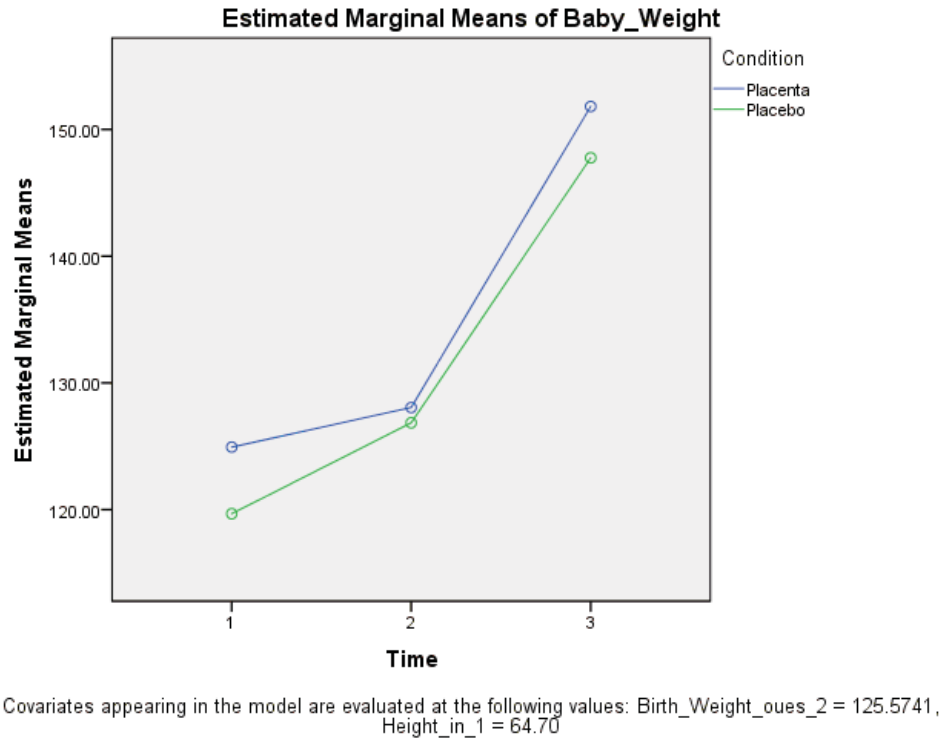

Figure 5.4 Infant weight (ounces) across postpartum meetings by condition

Research Question 2

The second research question addresses whether there are differences in salivary and plasma hormone levels within and between participants, and whether hormone and micronutrient levels are correlated to changes in postpartum affect, energy and recovery. Repeated measures ANOVA analysis was performed for prolactin, progesterone, and estradiol to identify differences between groups in hormone measures, as well as changes in hormone measures across the 3 postpartum

meetings, both within and between groups. Data that did not meet the normality assumption were log-transformed prior to repeated measures ANOVA analysis. Data that did not meet the normality assumption after log transformation were rank transformed prior to repeated measures ANOVA analysis.

Relationships between hormone measures (prolactin, estradiol, and progesterone) and psychometric variables (depressive symptoms, fatigue, and bonding) were evaluated using Spearman's rank-order correlation analysis because the assumption of normality was not met for these data. To correct for inflated Type I error due to the number of correlation analyses conducted, relationships were considered significant at an alpha level of $p < 0.01$ for all correlations analyses, however, non-significant relationships at an alpha level of $p < 0.05$, may be of interest and are noted as well.

These hormones were selected because they are noted by placentophagy advocates as potential candidates for the mechanism by which placentophagy elicits the purported effects, and because they are known to affect the variables addressed in section 5.3 above that are often claimed as benefits of placentophagy (*e.g.*, effects of estradiol and progesterone on mood and energy, and effects of prolactin on bonding and breast milk production). Additionally, both estradiol and progesterone were found to be present in the dehydrated placenta capsule samples in higher concentrations than most of the other hormones evaluated (see Table 5.4 below), and in concentrations that may possibly elicit physiological effects, making them good candidates for a role in the reported benefits of placentophagy.

Prolactin. Differences in plasma prolactin within-subjects and between groups were evaluated using repeated-measures ANOVA across the three postpartum meetings. The

following variables that may impact prolactin measures were included in the analysis: plasma prolactin during pregnancy, whether the infant is breastfed (self-reported), number of hours postpartum at time of sample collection, and number of minutes since the infant was last fed at the time of samples collection. Because prolactin values were not normally distributed, they were log10 transformed prior to repeated-measures ANOVA analysis. Between-subjects analysis revealed no significant difference between groups in whether the infant is breastfed, number of hours postpartum at time of sample collection, and number of minutes since the infant was last fed at the time of samples collection, therefore these control variables were removed, and the analysis was repeated for log 10 transformed prolactin concentration, controlling for plasma prolactin during pregnancy.

Mauchly's test indicated that the sphericity assumption was violated ($X^2(2) = 21.153$, $p < 0.001$), so the Greenhouse-Geisser correction was applied ($\varepsilon = 0.624$). Within-subjects analysis showed that there was not a significant main effect of time across the three postpartum meetings ($F(2, 27) = 0.221$, $p = 0.696$), indicating that plasma prolactin did not change significantly over time for both groups combined. There were also non-significant interactions of time and condition ($F(2, 27) = 0.523$, $p = 0.514$), and time and plasma prolactin during pregnancy ($F(2, 27) = 0.481$, $p = 0.535$) indicating that condition and plasma prolactin during pregnancy did not interact with time to predict postpartum prolactin levels. Between-subjects tests show that the variable condition is not significant ($F(1, 27) = 1.561$, $p = 0.224$), indicating that, overall, prolactin levels were the same for both groups when time is not considered. Analysis also showed that the control variable pregnancy prolactin level is significantly related to postpartum plasma prolactin levels ($F(1, 27) = 5.685$, $p = 0.025$). (See Figure 5.5).

Spearman's rank-order correlation was used to determine the relationship between

participants' plasma prolactin level and maternal attachment/bonding (PAI/MIB Scores) at each of the four meetings. There was no significant relationship between plasma prolactin and PAI/MIB score during pregnancy ($r_s(25) = 0.280$, $p = 0.157$), or at any of the 3 postpartum time points (first postpartum meeting: $r_s(25) = 0.000$, $p = 0.999$; second postpartum meeting: $r_s(25) = -0.172$, $p = 0.392$; third postpartum meeting: $r_s(25) = 0.900$, $p = 0.656$). Correlations between plasma prolactin and attachment/bonding were evaluated within each group (treatment and control), and revealed no significant correlations within either group at any time point.

Spearman's rank-order correlation analysis was also run to determine the relationship between participants' plasma prolactin level and postpartum depressive symptoms (EPDS score) at each of the four meetings. There was no significant relationship between prolactin and EPDS score during pregnancy ($r_s(25) = 0.094$, $p = 0.641$), or at any of the 3 postpartum time points (first postpartum meeting: $r_s(25) = -0.403$, $p = 0.037$; second postpartum meeting: $r_s(25) = -0.025$, $p = 0.902$; third postpartum meeting: $r_s(25) = -0.088$, $p = 0.661$). Correlations between plasma prolactin and EPDS score were evaluated within each group (treatment and control) as well, and revealed no significant correlations within either group at any time point.

Progesterone. Differences in salivary progesterone within-subjects and between groups were evaluated using repeated-measures ANOVA across the three postpartum meetings. The following variables that may impact progesterone measures were included in the analysis: salivary progesterone during pregnancy, maternal age, and the number of hours postpartum at time of sample collection. Because progesterone values were not normally distributed, all continuous variables were rank transformed prior to repeated-measures ANOVA analysis. Between-subjects analysis revealed no significant difference between groups in maternal

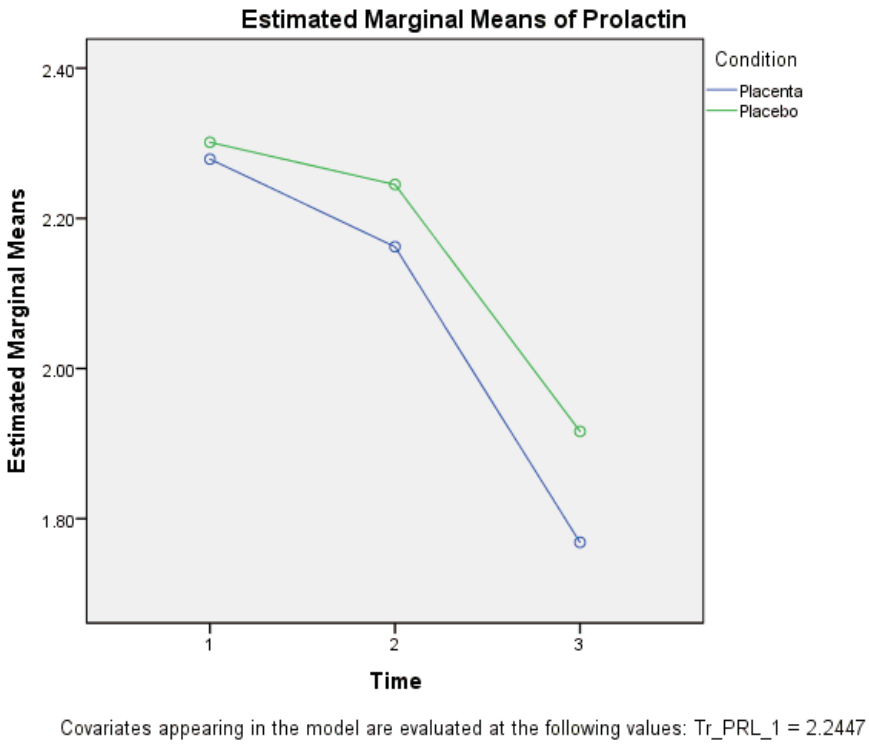

Figure 5.5 Plasma prolactin concentration across postpartum meetings by condition

age and pregnancy progesterone values, however there was a significant effect of the number of hours postpartum at time of the second postpartum meeting, therefore the control variables maternal age and pregnancy progesterone levels were removed, and the analysis was repeated for progesterone, controlling for the number of hours postpartum at the second postpartum meeting.

Within-subjects analysis showed that there was a significant main effect of time across the three postpartum meetings ($F(2, 27) = 22.658$, $p < 0.001$), indicating that salivary progesterone concentrations changed significantly over time for both groups combined. Pairwise comparisons using the Bonferroni adjustment indicated that mean overall progesterone concentrations decreased significantly from the first to second ($p < 0.001$), and first to third postpartum meetings ($p < 0.001$), but not from the second to third postpartum meeting ($p =$

1.000). There was a significant interaction of time and hours postpartum at the second postpartum meeting ($F(2, 27) = 10.343$, $p < 0.001$) indicating that hours postpartum at the second meeting interacted with time to predict postpartum salivary progesterone levels. There were a non-significant interaction of time and condition ($F(2, 27) = 1.772$, $p = 0.181$) indicating that condition did not interact with time to predict postpartum salivary progesterone levels. Between-subjects tests show that the variable condition is not significant ($F(1, 27) = 2.761$, $p = 0.110$), indicating that, overall, progesterone levels were the same for both groups when time is not considered. Analysis also showed that the control variable, hours postpartum at meeting 2, is significantly related to postpartum salivary progesterone levels ($F(1, 27) = 9.180$, $p = 0.006$). (See Figure 5.6).

Spearman's rank-order correlation was used to determine the relationship between participants' salivary progesterone levels and depressive symptoms (EPDS) at each of the four meetings. There was no significant relationship between salivary progesterone levels and EPDS score during pregnancy ($r_s(25) = 0.280$, $p = 0.157$), or at any of the 3 postpartum time points (first postpartum meeting: $r_s(25) = 0.000$, $p = 0.999$; second postpartum meeting: $r_s(25) = -0.172$, $p = 0.392$; third postpartum meeting: $r_s(25) = 0.900$, $p = 0.656$). Correlations between salivary progesterone and EPDS score were evaluated within each group (treatment and control), and revealed no significant correlations within either group at any time point.

Spearman's rank-order correlation analysis was also run to determine the relationship between participants' salivary progesterone levels and attachment/bonding (MIB score) at each of the four meetings. There was no significant relationship between progesterone and MIB score during pregnancy ($r_s(25) = 0.094$, $p = 0.641$), or at the first and third postpartum time points (first postpartum meeting: $r_s(25) = -0.403$, $p = 0.037$; third postpartum meeting: $r_s(25) = -0.088$,

$p = 0.661$), however, there was a moderate positive correlation between salivary progesterone and MIB score at the second postpartum meeting ($r_s(25) = 0.494$, $p = 0.009$). Correlations between salivary progesterone levels and MIB score were evaluated within each group (treatment and control) as well, and revealed no significant correlations within either group at any time point, although there was a moderate positive correlation between progesterone and bonding at the second postpartum meeting in the control group only that was not statistically significant at an alpha level of $p < 0.01$, but is worth noting ($r_s(25) = 0.589$, $p = 0.021$).

Spearman's rank-order correlation analysis was also run to determine the relationship between participants' salivary progesterone levels and energy/fatigue (FAS score) at each of the four meetings. There was no significant relationship between progesterone and FAS score during pregnancy ($r_s(25) = 0.167$, $p = 0.405$), or at any of the 3 postpartum time points (first postpartum meeting: $r_s(25) = 0.144$, $p = 0.474$; second postpartum meeting: $r_s(25) = 0.093$, $p = 0.646$; third postpartum meeting: $r_s(25) = 0.083$, $p = 0.682$). Correlations between salivary progesterone levels and FAS score were evaluated within each group as well, and revealed no significant correlations within either group at any time point.

Estradiol. Differences in salivary estradiol within-subjects and between groups were evaluated using repeated-measures ANOVA across the three postpartum meetings. The following variables that may impact estradiol measures were included in the analysis: salivary estradiol during pregnancy, maternal age, the time of sample collection, and the number of hours postpartum at time of sample collection. Because estradiol values were not normally distributed, all continuous variables were rank transformed prior to repeated-measures ANOVA analysis. Between-subjects analysis revealed no significant between-subjects effects of any control

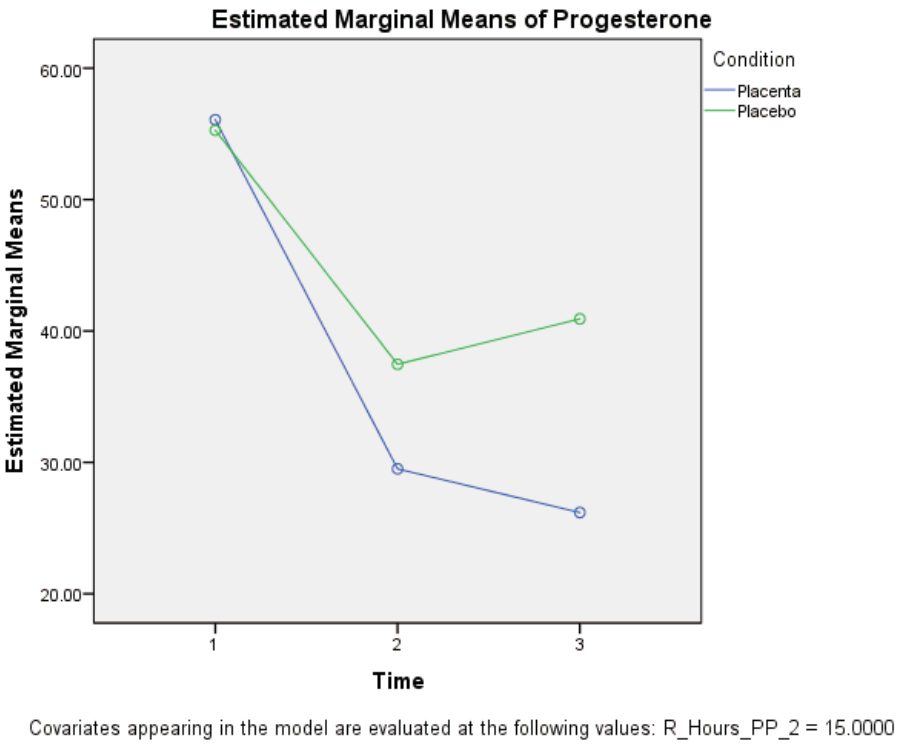

Figure 5.6 Salivary progesterone concentration across postpartum meetings by condition

variables, therefore the control variables were removed, and the analysis was repeated for rank transformed estradiol values.

Within-subjects analysis showed that there was a significant main effect of time across the three postpartum meetings ($F(2, 27) = 24.107$, $p < 0.001$), indicating that salivary estradiol concentrations changed significantly over time for both groups combined. Pairwise comparisons using the Bonferroni adjustment indicated that mean overall estradiol concentrations decreased significantly from the first to second ($p < 0.001$), and first to third postpartum meetings ($p < 0.001$), but not from the second to third postpartum meeting ($p = 1.000$). There was a non-significant interaction of time and condition ($F(2, 27) = 1.434$, $p = 0.248$) indicating condition did not interact with time to predict postpartum salivary estradiol levels. Between-subjects tests revealed that the variable condition is not significant ($F(1, 27) = 0.089$, $p = 0.768$), indicating

that overall, estradiol levels were the same for both groups when time is not considered. (See Figure 5.7).

Spearman's rank-order correlation was used to determine the relationship between participants' salivary estradiol levels and depressive symptoms (EPDS) at each of the four meetings. There was a moderate negative correlation between salivary estradiol levels and EPDS score during pregnancy ($r_s(25) = -0.487$, $p = 0.010$), but not at any of the 3 postpartum time points (first postpartum meeting: $r_s(25) = 0.182$, $p = 0.364$; second postpartum meeting: $r_s(25) = -0.069$, $p = 0.773$; third postpartum meeting: $r_s(25) = 0.117$, $p = 0.562$). Correlations between salivary estradiol and EPDS score were evaluated within each group (treatment and control), and revealed a strong negative correlation between estradiol and EPDS score during pregnancy in the control group only ($r_s(25) = -0.849$, $p < 0.001$), and no other significant correlations within either group at any time point.

Spearman's rank-order correlation analysis was also run to determine the relationship between participants' salivary estradiol levels and energy/fatigue (FAS score) at each of the four meetings. There was no significant relationship between progesterone and FAS score during pregnancy ($r_s(25) = -0.133$, $p = 0.510$), or at any of the 3 postpartum time points (first postpartum meeting: $r_s(25) = 0.125$, $p = 0.534$; second postpartum meeting: $r_s(25) = 0.125$, $p = 0.534$; third postpartum meeting: $r_s(25) = 0.201$, $p = 0.315$). Correlations between salivary progesterone levels and FAS score were evaluated within each group as well, and revealed no significant correlations within either group at any time point.

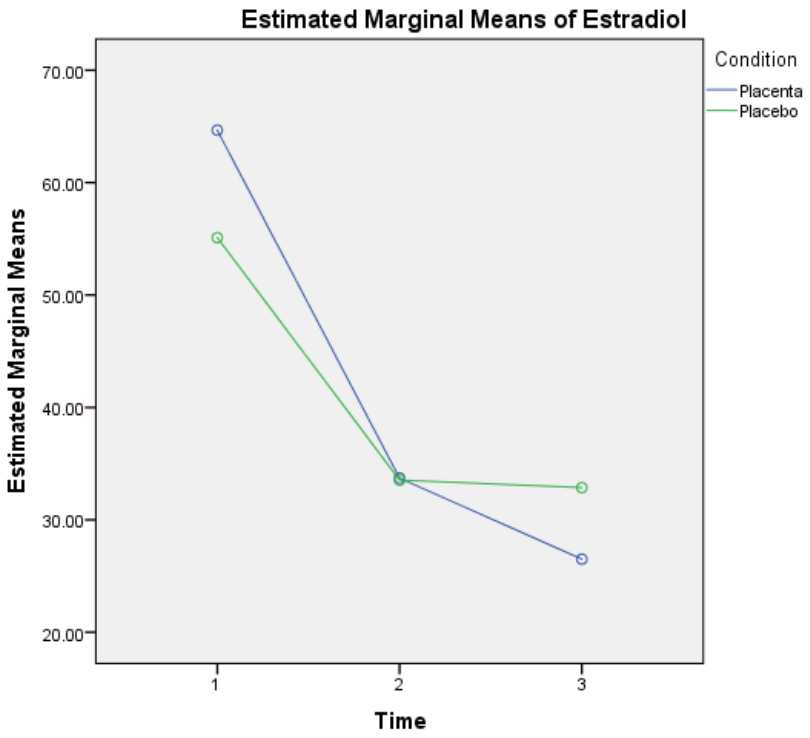

Figure 5.7 Salivary estradiol concentration across postpartum meetings by condition

Research Question 3

The third research question addresses the content of hormones, micronutrients, and environmental metals in dehydrated and encapsulated placenta. Concentrations of these substances were evaluated in 28 dehydrated placenta samples, as well samples of the beef and vegetarian placebo contents as a comparison. The placenta samples analyzed here include samples from two participants whose data was excluded from the analyses described in sections 5.3 and 5.4, as the reasons they were excluded from those analyses are not sufficient to exclude theses data here. Additionally, no placenta sample was collected from one participant whose data were included previously, therefore the hormonal and nutritional contents of her placenta capsules could not be include here.

Hormonal content of encapsulated placenta. The concentration of 17 hormones was evaluated in 28 samples of dehydrated placenta prepared for encapsulation, and in 3 samples of beef and 3 samples of vegetarian placebo contents. These include: 11-deoxycortisol, 17-hydroxyprogesterone, 7-keto DHEA, aldosterone, allopregnanolone, androstenedione, corticosterone, cortisol, cortisone, DHEA, DHT, estradiol, estriol, estrone, melatonin, progesterone, and testosterone. Spearman's rank-order correlation analysis was also run to determine the relationship between hormone concentrations in prepared placenta and participants' salivary hormone concentrations post-supplementation at Meetings 3 and 4 for estradiol and progesterone. Prolactin values in placenta and participant plasma could not be compared as prolactin was not measured in the placenta samples.

Fifteen of the 17 hormones were detected in all 28 placenta samples. Melatonin was detected in only one third of the placenta samples (n = 9, 33.3%), and DHT was not detected in any of the 28 samples, indicating that in these samples these hormones were either not present, or were present in concentrations that were below the limit of detection for this analysis. Mean, range, and standard deviation for each analyte in placenta capsule contents, and beef and vegetarian placebo contents are reported in Table 5.4. Mean concentrations of each hormone in each type of capsule (placenta, beef placebo, and vegetarian placebo) for the three capsule doses administered during this study (6 capsules, 4 capsules, and 2 capsules) are reported in Appendix B, Table 5.4.

Estradiol. Spearman's rank-order correlation analysis was run to determine the relationship between the estradiol concentration of the placenta capsules and salivary estradiol levels at the second (meeting 3) and third (meeting 4) postpartum meetings (post-

supplementation). Analysis revealed no significant relationship between salivary estradiol and estradiol in placenta samples for the treatment group at meeting 3 ($r_s(12) = 0.637$, $p = 0.026$), and at meeting 4 ($r_s(12) = -0.208$, $p = 0.517$). In order to address whether any relationships between placental and salivary hormone levels can be attributed to relationships between circulating and placental hormone concentrations in general, Spearman's rank-order correlation analysis was also conducted for the control group. Analysis also revealed that there was not a significant correlation between placental and salivary estradiol in the control group at either meeting (meeting 3, $r_s(15) = -0.080$, $p = 0.786$; meeting 4, $r_s(15) = 0.165$, $p = 0.556$). Although analysis revealed no significant relationship between placental and salivary estradiol post-supplementation in either group, there was a strong, positive correlation ($r_s(12) = 0.637$, $p = 0.026$) at the third meeting between estradiol in the placenta capsules and salivary estradiol for the treatment group only that is worth noting, although it is not significant at an alpha level of $p < 0.01$.

Progesterone. Spearman's rank-order correlation analysis was run to determine the relationship between the progesterone concentration of the placenta capsules and salivary progesterone levels at the second (meeting 3) and third (meeting 4) postpartum meetings (post-supplementation). Analysis revealed no significant relationship between salivary progesterone and progesterone in placenta capsules for the treatment group at meeting 3 ($r_s(12) = -0.091$, $p = 0.778$), and at meeting 4 ($r_s(12) = -0.134$, $p = 0.677$). In order to address whether any relationships between placental and salivary hormone levels can be attributed to relationships between circulating and placental hormone concentrations in general, Spearman's rank-order correlation analysis was also conducted for the control group. Analysis also revealed that there

Table 5.5

Mean concentration of hormones in each capsule dose (μg/g)

Element	High Dose (6 capsules) Days 1-4 of Supplementation			Medium Dose (4 capsules) Days 5-12 of Supplementation			Low Dose (2 capsules) Days 13-21 of Supplementation		
	Placenta (N=28)	Beef Placebo (N=3)	Vegetarian Placebo (N=3)	Placenta (N=28)	Beef Placebo (N=3)	Vegetarian Placebo (N=3)	Placenta (N=28)	Beef Placebo (N=3)	Vegetarian Placebo (N=3)
11-Deoxycortisol	0.172 ± 0.072	0.002 ± 0.001	<LOD	0.115 ± 0.048	0.001 ± 0.001	<LOD	0.057 ± 0.024	0.001 ± 0.000	<LOD
17-Hydroxyprogesterone	0.876 ± 0.653	<0.001	<LOD	0.584 ± 0.435	<0.001	<LOD	0.292 ± 0.217	<0.001	<LOD
7-keto DHEA	0.073 ± 0.033	<LOD	<LOD	0.048 ± 0.022	<LOD	<LOD	0.024 ± 0.011	<LOD	<LOD
Aldosterone	0.004 ± 0.002	<LOD	<LOD	0.002 ± 0.001	<LOD	<LOD	0.001 ± 0.000	<LOD	<LOD
Allopregnanolone	0.366 ± 0.136	<LOD	0.018 ± 0.007	0.244 ± 0.090	<LOD	0.012 ± 0.005	0.122 ± 0.045	<LOD	0.006 ± 0.002
Androstenedione	1.207 ± 0.698	0.001 ± 0.000	0.001 ± 0.000	0.805 ± 0.465	<0.001	0.001 ± 0.000	0.402 ± 0.232	<0.001	<0.001
Corticosterone	0.05 ± 0.042	0.005 ± 0.004	<LOD	0.033 ± 0.028	0.003 ± 0.002	<LOD	0.016 ± 0.014	0.002 ± 0.001	<LOD
Cortisol	0.279 ± 0.177	0.044 ± 0.017	<LOD	0.186 ± 0.118	0.029 ± 0.011	<LOD	0.093 ± 0.059	0.015 ± 0.006	<LOD
Cortisone	3.945 ± 1.298	0.008 ± 0.002	<LOD	2.63 ± 0.865	0.005 ± 0.002	<LOD	1.315 ± 0.432	0.003 ± 0.001	<LOD
DHEA	0.279 ± 0.168	0.002 ± 0.001	<LOD	0.186 ± 0.112	0.002 ± 0.000	<LOD	0.093 ± 0.056	0.001 ± 0.000	<LOD
DHT	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Estradiol	0.341 ± 0.11	<LOD	<LOD	0.227 ± 0.073	<LOD	<LOD	0.113 ± 0.036	<LOD	<LOD
Estriol	2.482 ± 0.402	<LOD	<LOD	1.654 ± 0.268	<LOD	<LOD	0.827 ± 0.134	<LOD	<LOD
Estrone	1.133 ± 0.327	<LOD	<LOD	0.755 ± 0.218	<LOD	<LOD	0.377 ± 0.109	<LOD	<LOD
Melatonin	<0.001	<0.001	<LOD	<0.001	<0.001	<LOD	<0.001	<0.001	<LOD
Progesterone	37.336 ± 6.878	0.003 ± 0.002	0.013 ± 0.003	24.89 ± 4.585	0.002 ± 0.001	0.009 ± 0.002	12.445 ± 2.292	0.001 ± 0.001	0.004 ± 0.001
Testosterone	0.100 ± 0.074	<0.001	<LOD	0.067 ± 0.049	<0.001	<LOD	0.033 ± 0.024	<0.001	<LOD

Values are means ± SD

<LOD: Below the limit of detection

was not a significant correlation between placenta capsule and salivary progesterone in the control group at either meeting (meeting 3, $r_s(15) = 0.127$, $p = 0.535$; meeting 4, $r_s(15) = 0.281$, $p = 0.156$).

Environmental metal and micronutrient content of encapsulated placenta. In order to investigate the concentration of beneficial micronutrients and potentially harmful environmental metals in processed placenta capsules, 28 samples of dehydrated placenta prepared for encapsulation were analyzed using inductively coupled plasma mass spectrometry analysis (ICP-MS). The concentration of 14 elements was evaluated, including arsenic (As), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), mercury (Hg), molybdenum (Mo), rubidium (Rb), selenium (Se), strontium (Sr), and zinc (Zn). Thirteen of the 14 elements evaluated were detected in all 28 placenta samples. The element that was not detected in all samples, Hg, was detected in 24 (85.7%) of the 28 samples, indicating that it was either not present or was present in concentrations that were below the limit of detection using ICP-MS analysis in 4 of the samples. Seven (50.0%) of the elements had a mean concentration below 0.1 parts per million (ppm), including As, Cd, Co, Pb, Hg, Mo, and U. Mean, range, and standard deviation for each analyte in placenta capsule contents are reported in Table 5.6 (Appendix C).

Iron is the most highly concentrated element in the dehydrated placenta samples (664.38 ppm), followed by Zn (54.63 ppm), Rb (8.03 ppm), Cu (5.58 ppm), Sr (1.51 ppm), and Se (1.51 ppm). Conversely, the environmental metals that are of the greatest health concern, especially for postpartum women who may be breastfeeding, are seen in very low concentrations (*e.g.,* As, Cd, Pb, Hg, and U), and all below 0.1 ppm. Mean concentrations for each analyte in each type of

capsules (placenta, beef placebo, and vegetarian placebo) for the three capsule doses administered during this study (6 capsules, 4 capsules, and 2 capsules) are reported in table 5.7.

Summary

This chapter presents results of a subset of the current project intended to address the most widely claimed effects of placentophagy, and the longstanding question of the hormonal and nutritional composition of dehydrated placenta supplements. Analysis revealed a significant effect of placentophagy on postpartum mood and energy, but not on maternal bonding or infant weight. Further analysis revealed that although there were significant changes in some salivary and plasma hormone levels over time, no significant differences in postpartum hormone concentrations between groups were revealed, and there were no significant relationships between plasma and salivary hormone measures and depressive symptoms, energy, or maternal bonding.

Concentrations of hormones, trace micronutrients, and environmental metals were evaluated in placenta and placebo capsule contents, and analysis revealed no significant relationship between concentration of hormones in the placenta and participants' salivary hormone levels with the exception of salivary estradiol during pregnancy in the control group only. The next chapter provides discussion and interpretation of these findings, limitations of the study, and future recommendations.

Footnotes:

[1] Improved iron rebound is a commonly reported benefit of placentophagy supporters, and iron deficiency and iron deficiency anemia have been reported in women with postpartum depressive symptoms. Three iron measures were collected as a part of this study, however they are not included in the present analysis. The effects of placentophagy on these iron measures is reported in detail in Gryder, 2015.

Table 5.7 Mean concentrations of elements in each of 3 capsule doses (mg/g)

Element	High Dose (6 capsules) Days 1-4 of Supplementation			Medium Dose (4 capsules) Days 5-12 of Supplementation			Low Dose (2 capsules) Days 13-21 of Supplementation		
	Placenta[a] (N=28)	Beef Placebo (N=1)	Vegetarian Placebo (N=1)	Placenta[a] (N=28)	Beef Placebo (N=1)	Vegetarian Placebo (N=1)	Placenta[a] (N=28)	Beef Placebo (N=1)	Vegetarian Placebo (N=1)
As	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cd	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Co	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	0.018 ± 0.003	0.0121	0.044	0.012 ± 0.002	0.008	0.029	0.006 ± 0.001	0.004	0.015
Fe	2.192 ± 0.532	0.307	0.051	1.461 ± 0.355	0.204	0.034	0.73 ± 0.177	0.102	0.017
Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mn	0.002 ± 0.001	0.001	0.452	0.001 ± 0.000	<0.001	0.301	<0.001	<0.001	0.151
Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mo	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Rb	0.026 ± 0.006	0.068	0.003	0.017 ± 0.004	0.045	0.002	0.008 ± 0.002	0.023	0.001
Se	0.004 ± 0.000	<0.001	<0.001	0.003 ± 0.000	<0.001	<0.001	0.001 ± 0.000	<0.001	<0.001
Sr	0.014 ± 0.013	<0.001	0.015	0.009 ± 0.009	<0.001	0.010	0.004 ± 0.004	<0.001	0.005
U	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	0.180 ± 0.018	0.562	0.671	0.120 ± 0.012	0.374	0.448	0.06 ± 0.006	0.187	0.224

[a]Values are means ± SD

Chapter 6: Discussion

This chapter provides a discussion of the results presented in the previous chapter. This includes a review and interpretation of each measure evaluated to address the research questions presented in Chapter 3, as well as the limitations of the study.

Research Question 1

Does placentophagy, in the form of dehydrated capsules, improve postpartum affect, energy and recovery in comparison to a vegetarian or beef placebo supplement?

Postpartum depression. Postpartum depressive symptoms were evaluated using the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987) and although there was no significant difference between groups in depression score overall, there was a significant interaction of time and condition that predicted trends in EPDS score. As illustrated in figure 5.1, participants receiving the placenta supplement experienced a significant decrease in depressive symptoms between the first and second postpartum meetings (pre-supplementation to early post-supplementation), followed by a non-significant increase in symptoms form the second to final postpartum meetings. Control group participants, however, experienced a slight non-significant increase in depressive symptoms overall across the postpartum period.

Previous research on placentophagy among mothers in industrialized countries suggests that the primary benefit women claim as a result of ingesting placenta postpartum is the relief or prevention of postpartum depressive symptoms (Selander et al., 2013). Research on postpartum affect has shown that postnatal blues manifests early in the postpartum period, with many researchers identifying a peak in symptoms around day 5 postpartum (Henshaw, 2003)

(approximately the time of the second postpartum participant meeting in this study), and resolves within a few days (Robertson et al., 2004). Unlike postnatal blues, postpartum depression typically manifests within 6 weeks postpartum and has a longer duration (Robertson et al., 2004). Given these sensitive time frames for postnatal affective lability, if placentophagy is effective in mitigating some of these changes, we would expect to see significantly lower post-supplementation postpartum depression scores in the treatment group compared to the control group, significant post-supplementation decreases in depressive symptoms in the treatment group in comparison to the control group, or both. While the results did not show significantly lower EPDS scores in the treatment group at any postpartum time point, they did indicate that the treatment group experienced a significant decrease in depressive symptoms from the first postpartum meeting (within 96 hours postpartum) to the second (between days 5-7 postpartum). The EPDS score did show a statistically insignificant increase in this group, however, from the second to final postpartum meeting (week 3 postpartum).

It is worth noting that the dose of placenta or placebo capsules taken across the postpartum period in this study decreased over time, from 6 capsules daily on days 1-4 of supplementation, to 4 capsules daily on days 5-12 of supplementation, to 2 capsules daily for the remainder of participation in the study. If the decrease in EPDS score in the early postpartum period did in fact result from taking the placenta supplement, it is possible that this decrease in depressive symptoms, followed by the subsequent increase in symptoms, was influenced by the decreased dose of capsules over time, as participants were taking 6 capsules daily at the second postpartum meeting, and only 2 daily at the final meeting. It is also possible that other factors are responsible for the difference between groups in the change in depressive symptoms immediately post-supplementation. For example, one participant in the treatment group noted that she

experienced an improvement in mood when she started taking the capsules, but noticed an increase in feelings of depression when the dose decreased. She noted that this timing also coincided with her mother leaving after having stayed with her for the first week postpartum, suggesting that this could have affected her mood. Because many experiences during pregnancy and the postpartum period could potentially effect postpartum depressive symptoms, especially social support and a history of depression, these measures were included as possible controls in the statistical model for this study, decreasing the likelihood that one of these factors was responsible for the between groups difference in change in depressive symptoms.

Fatigue. In order to address the effects of placentophagy on postpartum fatigue, scores on the Fatigue Assessment Scale (Michielsen et al., 2004) were evaluated, controlling for postpartum sleep quality. While there was no significant difference between groups for FAS score overall during the postpartum period, there was a significant interaction of time and condition on FAS score, indicating that condition interacted with time to predict trends in FAS score. Figure 5.2 illustrates the different trends in FAS score between women in the treatment and control groups, with participants in the placenta group experiencing a slight, non-significant decrease in fatigue score over time, and the control group experiencing a slight, non-significant decrease in fatigue between the second and third postpartum meetings, followed by a non-significant increase in FAS score between the last two meetings. Additionally, although not significantly different between groups, treatment group participants entered the postpartum period with a higher mean FAS score than the control group, and completed the study with a significantly lower final FAS score. Thus, it appears the women receiving the placenta supplement experienced decreased fatigue while women receiving the placebo supplement

experienced increased fatigue across the study period, which would be expected if placenta supplements do in fact improve postpartum energy as claimed by placentophagy supporters.

Because sleep quality is negatively related to fatigue score, the difference in postpartum changes in fatigue between groups could be related to sleep quality, which may or may not have been impacted by the type of supplement received. This analysis controlled for sleep quality, however, making this an unlikely source for the differences seen here. Another suspected cause for the reported increase in energy/decrease in fatigue among women who ingest placenta postpartum is the presumed iron content in placenta supplements (and in placenta in general). Given the inverse relationship between iron and fatigue, and the benefits for reducing fatigue through iron supplementation that are reported in the scientific literature (Patterson et al., 2001; Vaucher et al., 2012; Verdon et al., 2003), it is possible that differences in iron levels between groups may be responsible for the different trends in FAS score between groups seen here. Although between group differences and changes in iron across the study were not evaluated for this dissertation, Gryder (2015) assessed three different measures of iron status across the postpartum period in women from the sample of participants in this study and found no significant difference between groups in iron measures across the study. Rather, Gryder found that although iron measures in the treatment group were slightly lower than those of the control group, they changed across the study in parallel ways, and there were no significant differences between groups with respect to iron deficiency at any time point in the study, or in sources of heme and non-heme iron between groups. Given that placentophagy did not impact participant iron status across the study period, it is unlikely that iron received through the placental supplements had a positive impact on fatigue scores in the treatment group here. Additionally, analysis of the micronutrient content of the placenta capsules in this study revealed only a

modest amount of iron in the placenta supplements – even at the highest dose administered during the study, making iron from the placenta capsules themselves an unlikely source of improvements in fatigue.

Although the effects of placentophagy on fatigue have not previously been evaluated empirically, a Korean study in which injections of human placental extract or a saline placebo were administered to perimenopausal women found that women who received injections of placental extract had decreased fatigue compared to those who received the saline placebo injection (Kong et al., 2008). These results are consistent with the findings of the effects of postpartum placenta supplementation presented here.

Bonding. There was neither a significant overall change over time, nor a significant difference between groups in overall maternal bonding score as measured by the Mother-to-Infant Bonding Scale (Taylor et al., 2005). The treatment group experienced a slight, non-significant increase in bonding score (indicating decreased bonding with their infant) followed by a non-significant decrease across the postpartum period, while the control group exhibited an overall non-significant increase. At the final postpartum meeting, however, the mean bonding score in the treatment group was significantly lower than that of the control group, indicating that the treatment group had higher maternal bonding at the end of the study. Although improved maternal bonding with the infant is often reported as a benefit of placentophagy, this claim was not fully supported by the current findings given that the change in bonding score did not decrease significantly in the treatment group, or increase significantly in the control group. This suggests that improved mother-to-infant bonding reported by women who have ingested placenta may be due to a placebo effect. It is also possible that bonding scale used in this study did not

capture nuanced differences between participants in feelings of bonding toward their infant. In both groups, participants reported overall very low scores on the bonding scale.

Given the participants who composed the sample in this study were highly self-selecting with regard to parenting style, as women who engage in placentophagy may be predisposed to express higher maternal infant bonding in general due to an increased likelihood of embracing "attachment parenting" practices (Benyshek & Young, 2015; Williams, 2014), it is possible that maternal bonding was elevated in these participants overall. If this is the case, the lack of significant changes in bonding score between groups across the postpartum study period may have resulted from these mothers being more highly bonded with their infants than would be expected in a representative sample.

Infant Weight. Infant weight was evaluated as a proxy for breast milk production, and in both the treatment and control groups, infant weight increased over the 3 postpartum meetings in similar ways, however this increase was not significant. There was also no significant difference in infant weight between the two groups. These results suggest that infant weight is not affected by postpartum supplementation with placenta capsules.

Although early research on the effects of dehydrated placenta on infant growth and breast milk production reported larger infant weight gains and greater breast milk production in women taking placenta powder, these results were not statistically significant (Hammett & McNeile, 1917a; 1917b), or were measured subjectively making the results difficult to interpret (Soykova-Pachnerova et al., 1954). The results of the present study are consistent with those reported in the early 1900s medical literature.

Research Question 2

Are there differences within and between the experimental and control groups (receiving placenta and placebo supplements, respectively) in concentration of salivary and plasma hormones across meetings, and are hormone levels correlated to measures of postpartum affect, energy and recovery?

Prolactin. Plasma prolactin levels in both the treatment and control groups decreased overall across the 3 postpartum meetings, however, this decrease did not change significantly over time, or between groups. This can be seen in figure 5.5, which illustrates that although prolactin appears to decline over time, both groups exhibit similar decreases with the lines in the figure running nearly parallel to one another.

There were also no significant correlations between plasma prolactin levels and postpartum depressive symptoms (EPDS score), or maternal attachment/bonding (PAI/MIB score) for the overall sample, the treatment group, or the control group. This suggests that in this study, pregnancy and postpartum plasma prolactin levels were not related to the presence of depressive symptoms, or maternal bonding.

Although the presence or absence of breastfeeding and the time of last infant feeding bout were accounted for in this analysis, it is possible that these factors may have affected the prolactin measures in his study. There is a positive correlation between breastfeeding and prolactin levels, therefore differences between groups in breastfeeding practices could have influenced prolactin levels in the study participants. Because these factors were controlled for statistically, however, it is unlikely that they are responsible for the lack of difference in prolactin levels or trends in the change in prolactin levels between groups.

Progesterone. Salivary progesterone concentrations declined significantly overall across the 3 postpartum meetings, however, the control group experienced a small, non-significant increase in progesterone between the second and final postpartum meetings, while progesterone levels in the treatment group continued to decline. There was also a significant interaction between time and number of hours postpartum at the second meeting (first postpartum meeting), showing that the timing of this meeting impacted salivary progesterone levels. This is consistent with what is expected given the 96 hour window in which participants met with researchers for the second time, and the known postpartum decline in progesterone that occurs over the first few days after parturition (Taylor & Lebovic, 2007). Although there was a significant change over time in salivary progesterone measures, this decline was not significantly different overall between the treatment and control groups. Although no literature exists on effects of placentophagy on hormone measures in human, research on the hormonal effects of placenta ingestion has been conducted in rodent modes. This research has shown that compared to rats who were prevented from eating their placenta postpartum, those who did ingest the organ had lower progesterone levels on the sixth and eighth days postpartum (Blank & Friesen, 1980). Another study conducted by Grota and Eik-Nes (1967) found the opposite in rats that were prevented from consuming the placenta. In this study, decreased levels of progesterone were found on the fourth day of lactation in rats that were prevented from ingesting the placenta compared to those allowed to consume the organ. Unlike the results reported in the rodent literature, postpartum endocrine changes in the human participants in both groups for this dissertation study showed similarly decreased progesterone levels between days 5 and 7

postpartum, with no significant difference in salivary progesterone measures between groups at this time point.

There were also no significant correlations between salivary progesterone concentrations and depressive symptoms (EPDS score), maternal attachment/bonding (PAI/MIB scores), and fatigue (FAS score), during pregnancy or at any of the postpartum meetings, with the exception of a moderate positive correlation between salivary progesterone and MIB score at the second postpartum meeting overall that was significant. This indicates that overall, as progesterone concentrations increased, maternal bonding decreased (increased bonding scores reflect decreased bonding with the MIB scale). When these relationships were investigated in the treatment and control groups separately, the treatment group did not exhibit a significant relationship between progesterone concentration and bonding, however the control group exhibited a moderate positive correlation between bonding score and progesterone levels at the second postpartum meeting that, although not significant, was interesting given the p-value of 0.021, and may warrant future investigation. This possible correlation is in contrast to previous research on the endocrinology of maternal attachment that has shown a relationship between the ratio of plasma estradiol to progesterone during pregnancy and postpartum maternal attachment, but not between postpartum progesterone and attachment (Fleming et al., 1997). While these results could suggest a possible relationship between increased progesterone and decreased maternal bonding that results from a lack of placentophagy, this could also be an artifact of the endocrinology of human lactation. Given that progesterone has an inhibitory effect on prolactin's action on mammary tissue, and may therefore impact lactation (Goodman, 2003), the inverse relationship between progesterone and bonding seen in the current study could be an artifact of the relationship between lactation and maternal feelings of bonding (Labbok, 2001).

Estradiol. Postpartum concentrations of salivary estradiol showed an overall significant decrease across the 3 postpartum meetings, specifically from the first to second, and first to third postpartum meetings, however, there was not a significant difference in mean overall estradiol concentrations between groups. This means that although estradiol concentrations decreased over time, they changed in similar ways in both groups. The rapid decline of estradiol across the first few days postpartum that was seen in the present study is consistent with the return of estradiol to prepartum levels within a few days of parturition that has been documented in the medical literature (Taylor & Lebovic, 2007). Although no prior research has evaluated the effects of placentophagy on postpartum estradiol, the previously mentioned study in which injections of human placental extract or a saline placebo were administered to perimenopausal women found that women who received placenta injections had increased estradiol levels compared to those who received a saline placebo injection (Kong et al., 2008). The results of the current study are not consistent with these findings, and did not find a relationship between placenta supplementation and estradiol levels.

Salivary estradiol and EPDS score during pregnancy were moderately negatively correlated in the overall sample, and after evaluating each group separately, this correlation remained in the control group, but not in the treatment group. This suggests that in control group participants, lower estradiol levels were related to increased depressive symptoms during pregnancy. Previous research on depression has suggested a role for decreases in estradiol in the manifestation of postpartum depressive symptoms (Bloch et al., 2000), and late pregnancy estradiol levels have also been shown to be lower in women with depression than in women who were not depressed (O'Hara et al., 1991).

Research Question 3

What is the concentration of select hormones, micronutrients, and environmental metals in dehydrated and encapsulated human placenta?

Hormonal content of encapsulated placenta. Analysis of the hormone concentrations in samples of 28 dehydrated placenta capsules revealed low concentrations for most of the analytes, with one hormone (DHT) below the limit of detection in every sample (see table 5.4). A number of factors affect the bioavailability and bioactivity of hormones (Fotherby, 1996), such as the route of exposure, individual lifestyle factors, and interactions between different hormones, making it difficult to know whether the hormones evaluated in these placenta samples are present in sufficient concentrations to elicit a physiological response. With this caveat in mind, the estrogens and progestogens are of particular interest here, given their concentrations at levels that may potentially be high enough to have physiological effects when administered in the highest dose of capsules taken by study participants.

The mean amount of each hormone (in μg) in each of the three doses and for each type of supplement administered in this study are reported in table 5.5. In comparison to the beef and vegetarian placebo contents, the dehydrated placenta supplement contained higher mean amounts of every hormone that was detected (all hormones except DHT). This is not surprising considering the critical role the placenta plays during pregnancy in endocrine function. The beef placebo capsules contained detectable concentrations of 10 hormones, albeit at much lower concentrations, and most of these were present in the beef placebo capsules in higher amounts than what was seen in the vegetarian placebo capsules, with the exception of allopregnanolone and progesterone which were slightly higher in the vegetarian placebo contents than the beef.

Previous research by Phuapradit and colleagues (2000) investigated the concentration of various substances in heat dried placentas from 15 male and 15 female births in Thailand. Among these substances were 3 hormones evaluated here, estradiol, progesterone, and testosterone. While their results similarly showed that all 3 steroids were retained in heat dried placental tissue, the concentrations were much lower than those found in this study, with the placental tissue analyzed in this study containing approximately 11.5 times the amount of estradiol, 83 times the amount of progesterone, and 1.5 times the amount of testosterone found in the heat dried placentas analyzed by Phuapradit and colleagues (2000). These differences in results could be due to geographical differences between placenta donors, differences in lifestyle characteristics such as diet or smoking, the preparation method used to dehydrate and process the placentas for analysis, or the analysis method employed.

Because proponents of placentophagy claim that the hormones and nutrients in placenta capsules are helpful in replenishing these substances that have been lost during parturition, and in providing these substances while the body returns to typical pre-pregnancy endocrine function, relationships between concentrations of estradiol and progesterone in the placenta capsules were compared to post-supplementation salivary measures of these analytes. In the present study, there was no significant relationship between placental and salivary concentrations of progesterone at either of the 2 time points after participants had begun supplementation, for either the treatment or control group. This suggests that the progesterone content of the capsules that the participants took during the study did not have a direct impact on women's salivary progesterone.

Estradiol concentrations in the dehydrated samples was also compared to salivary estradiol measures at the two post-supplementation meetings. As with progesterone, there was no

significant relationship between the two measures for either the treatment or control group at either of the 2 post-supplementation time points. There was, however, a strong positive correlation between the two salivary hormone measures at the first post-supplementation meeting (meeting 3) among treatment group participants that, while not statistically significant (p = 0.026), may be worth future investigation. Although the effects of oral intake of placenta supplements on estradiol levels has not been previously investigated, as discussed earlier, research with perimenopausal women receiving injections of human placental extract showed an increase in estradiol among these women, suggesting a relationship between the hormone in placental extract and circulating levels.

Micronutrient and environmental metal content of encapsulated placenta. Analysis of the concentration of micronutrients and environmental metals in placenta capsules contents from 28 placentas collected during this study revealed modest concentration of potentially beneficial micronutrients (i.e., iron, selenium, copper, and zinc), and negligible concentrations of potentially harmful elements (i.e., arsenic, cadmium, mercury, lead, and uranium).

The results of the elemental analysis presented here are somewhat consistent with the results of the study mentioned above that was conducted in Thailand where researchers measured concentrations of iron, zinc, copper, and manganese (among other minerals) in heat dried human placenta (Phuapradit et al., 2000) – the only other study to date, to my knowledge, to evaluate the concentration of nutrients in heat dried placental tissue. In the 30 placentas analyzed, the authors found a similar concentration of zinc as found in samples from this dissertation study, however, the samples analyzed in this study contained approximately two thirds the concentration of iron and manganese, and only about one tenth of the concentration of copper that was found by

Phuapradit and colleagues (2000). While the actual concentrations of each of these 4 analytes vary between studies, in both cases, iron is by far the most highly concentrated element, followed by zinc, then copper, and lastly, manganese.

Of greatest interest to placentophagy advocates are the micronutrients in dehydrated placenta capsules that have been suggested as a potential source of the purported benefits of the practice, particularly iron due to its inverse relationship with depression (Beard et al., 2005; Benton & Donohoe, 1999; Corwin et al., 2003) and fatigue (Patterson et al., 2001; Vaucher et al., 2012; Verdon et al., 2003), and because iron is typically lost through bleeding during parturition. Despite the belief by placentophagy advocates that placenta supplements provide a rich source of nutrients to the postpartum mother, the mean concentration of the essential micronutrients iron, selenium, zinc, and copper in this sample are modest to negligible, with a 6 capsule dose of placenta supplements accounting for approximately 24% (2.192 mg), 7.1% (0.005 mg), 1.5% (0.180 mg), and 1.4% (0.018 mg) of the recommended daily intake for lactating women of iron, selenium, zinc, and copper respectively (see Table 5.7). Although unlikely to account for substantive changes in postpartum affect, health, or recovery, these results suggest that placenta capsules may provide a modest but beneficial source of additional micronutrients for postpartum mothers. It is important to note, however, that the concentrations of these substances found in this study may not provide a sufficient source of postpartum nutrients on their own.

In addition to evaluating the beneficial substances present in placenta capsules, placentophagy researchers have raised concerns about potentially harmful substances, such as toxic environmental metals that may be retained in dehydrated placenta supplements (Hayes, 2015; Young et al., 2012; Young et al., 2016). The results presented here for the potentially harmful toxic elements arsenic, cadmium, lead, mercury, and uranium, as well those with no

established health benefit such as cobalt, rubidium, and strontium, suggest that these substances in dehydrated placenta are present in concentrations that do not raise concern. In the maximum daily dose of placenta supplement administered during this study (approximately 3300 mg), all but rubidium (0.026 ± 0.006 ppm) and strontium (0.014 ± 0.013 ppm) were measured in concentrations below 0.001 ppm, and all were well below the oral upper tolerable limits (UL) or minimal risk levels (MRL) established by the CDC (note that no UL or MRL is available for lead, elemental mercury, or rubidium) (ATSDR, 2015a, 2015b; also see Young et al., 2016b).

Summary of hormone and element content of placenta capsules. Given the results for the 14 elements evaluated in these placenta samples, it appears that placenta supplements may provide only a modest source of potentially beneficial micronutrients, and a negligible source of potentially toxic elements. It is important to note that although these results show that the toxic elements evaluated here are not present in high concentrations, this analysis does not include other potentially harmful substances that may be retained by the placenta and present in the capsules, such as pesticides and other environmental pollutants.

Because the placenta samples evaluated in this study were prepared by steaming, dehydrating, and pulverizing the organ, following the proprietary method of a single encapsulation provider, Placenta Benefits, LTD, it is possible that other preparation methods would result in different concentrations of hormones and elements in the resulting preparation (e.g., raw tissue, tissue cooked into a dish, or placenta that is dehydrated without prior steaming). Additionally, the dehydrated placenta samples collected in this study were limited to those of healthy women in the Las Vegas area who did not smoke cigarettes or drink alcohol during pregnancy, and many of whom were of higher socioeconomic status and were taking prenatal

nutritional supplements. As a result, these findings may not be broadly applicable across the US and other industrialized countries where women are engaging in this practice. Lifestyle factors such as diet, socioeconomic status, geographical location, medication use, and drug/cigarette/alcohol use can affect endocrine function as well as exposure to and uptake of different elements, which could lead to different concentrations of hormones and elements in the placenta capsules of women outside of this study.

Limitations

There are several limitations to the dissertation study presented here. Due to the nature of this study, participants were recruited through convenience sampling and from a population of women who had decided prior to enrollment in the study that they would be ingesting their placenta postpartum, thus the participants included here represent a biased sample. Because of this, the women in this study were highly motivated and believed that placenta offers postpartum benefits. Additionally, the women included in this study were all healthy, non-smokers who did not use recreational drugs or drink alcohol during pregnancy and were generally college educated, of higher socioeconomic status, and presumably adequately nourished. Other personality traits and parenting strategies mentioned previously that may be more prevalent in this self-selecting sample of women who elected to engage in placentophagy (e.g., attachment parenting strategies, use of doulas and lactation consultants, etc.) may also have impacted the outcomes measured in this study. While this may represent a typical mother who would opt to engage in placentophagy, this does not necessarily represent the demographic of the average pregnant woman in the US or other industrialized countries. These results, therefore, may not apply to women outside of this small sample of women in the Las Vegas area. The sample size in

this study, while sufficient to evaluate the questions addressed here, is also small and therefore less statistically powerful. Given this, a larger samples size may have allowed for more precise results.

Due to the inherently unpredictable nature of childbirth and the early postpartum period, many aspects of data collection were difficult to control. Ideally, each participant would have met with the research team after the same number of days postpartum, and at the same time of day. Although a standardized meeting scheduled was adhered to as closely as possible, this of course, was not feasible due to a number of factors such as the timing of the participant's release from the hospital. The data collection setting was also different for each participant, as all postpartum meetings occurred at the participant's residence. Because of this, environmental factors such as other people's presence and household distractions during the meeting were unable to be controlled. These and other circumstances that would have been difficult to control by design, such as timing of breastfeeding and contact with the infant, may have impacted the data collected in this study, particularly the hormones that were evaluated, as hormone levels can be very sensitive to context (e.g., circadian fluctuations, stressful situations, physical stimuli, etc.).

Because little scientific research has been conducted on placentophagy, the measures collected in this study, and the data collection schedule were designed through the consideration of women's self-reported experiences and in consultation with the founder of a local encapsulation provider service. Due to this limitation, the study design reflects one of many ways that placentophagy could be practiced, and the data collection timeline may have missed potentially important differences that could have occurred outside of the data collection windows. An additional limitation of this study is that the placenta supplement provided to

participants was processed using the proprietary method of Placenta Benefits, LTD, which process the placenta through steaming, dehydrated, and pulverizing the organ prior to encapsulation. While a 2013 study (Selander et al.) suggests that dehydrated and encapsulated placenta is the most common method of placentophagy, the capsules in this study represent only one of several methods of placenta preparation. Beyond this, within this type of preparation, there is no guarantee that each encapsulation provider is preparing the placenta in the same way. For example, some encapsulation providers, such as Placenta Benefits, LTD, will steam or cook the placenta prior to dehydration while others will dehydrate the raw organ without prior cooking. Given that some substances that may be present in placental tissue are more heat-stable than others, this difference in preparation method may produce differences in outcomes.

Additionally, the dosage of capsules administered in this study may not reflect that which is prescribed by other encapsulation providers. The dosage recommendations here were established through discussions with Jodi Selander of Placenta Benefits, LTD, based on the typical recommendation of this organization. Many encapsulation providers, including Selander, however, will instruct their clients to start with this recommended dosage and to adjust it as they see fit based upon their body's response to the dose. Finally, in addition to providing placenta capsules themselves, some encapsulation providers will also offer tinctures and even the steaming broth to some clients, which could provide additional sources of placental supplementation not accounted for in this study.

Looking carefully at the data collected in this study, there were also limitations to the measures used to evaluate some of the claims of placentophagy, specifically the use of infant weight as a proxy measure for breast milk production. While this has been used in previous medical research to address this question (Hammett & McNeile, 1917a), it is not the ideal

measure to identify differences in breastmilk production. While difficult to collect, a more precise method would have involved collecting pre- and post-feeding infant weights, and weights of remaining breast milk (through pumping) produced throughout the day at specified time points (see Dewey et al., 1991). These values combined would give a more accurate and direct value for breast milk production than infant weight alone. This particular methodology would have created undue burden on participants in this study and was thus not employed here.

Finally, the data collected during the course of this project far exceeds the scope of the data presented in this dissertation, therefore the effects of placentophagy on several other measures collected remain to be evaluated. Because of this, other aspects of the practice, and potential confounding variables may not have been accounted for in the dissertation analysis presented here.

Summary

In light of the limitations described above, and the limited scope of this dissertation, the results presented here can nonetheless shed light on some of the most pressing questions on the topic of human maternal placentophagy – namely, what are the physiological and psychological effects of the behavior and how does processing placental tissue for ingestion affect the concentration of potentially beneficial (and harmful) substances in the organ? The results of this dissertation suggest that while many of the claims evaluated in this project were not supported, postpartum supplementation with steamed and dehydrated placenta capsules may elicit some emotional and physiological changes that may not otherwise manifest in postpartum mothers. This includes a slight decrease in depressive symptoms in the early postpartum period (within the first week after parturition), improvements in fatigue over the first few weeks postpartum, and significantly

higher maternal bonding at approximately 3 weeks postpartum. Additionally, this research shows that many hormones and nutrients are retained in the placenta after it has been processed for encapsulation, something that skeptics have questioned about the possible efficacy of placenta supplements.

While some small effects were noted in this study in the treatment group that were not seen in control group participants, many of the claims evaluated were not supported. These include claims that placentophagy positively impacts maternal bonding, breastmilk production, and some postpartum hormone levels. While these experiences claimed by placentophagy supporters may be the result of a placebo effect, they may also be related to a very important aspect of human postpartum behavior – social support. While the capsules themselves may not have inherently beneficial properties for the postpartum mother, they bring with them an encapsulation provider, – and in the case of this study, two researchers – who is there with the mother during a time when social support is critical. Given the higher prevalence of natural and home birth practices and midwife and doula assisted births is expected among mothers who engage in placentophagy (Selander et al, 2013, the opportunity for additional social support surrounding parturition may be greater than that of the larger US population. The presence of, and support offered by an individual who is there to provide a service specifically for the mother, may provide emotional benefits as well. When I began data collection for this study, I was prepared for the participants to see these early postpartum meetings as an inconvenience, but to my surprise, they often seemed happy to see us and excited to talk about their birth story. Perhaps this additional social contact provided during the early postpartum period offers emotional support needed during this time.

This chapter reviewed the results presented in the previous chapter, and provided interpretations for these results in the context of what is currently known about the effects of placentophagy, and presented the limitations of the present study. The next chapter provides a summary of the dissertation, including a discussion of the significance, and potential future directions of this research.

Chapter 7: Conclusions

Summary of the Dissertation

This dissertation provides an overview of the current state of research on human maternal placentophagy, a review of the existing literature on the topic, a description of the methods employed to empirically test claims made about the growing practice of human maternal placentophagy in postpartum mothers, and a discussion of the results of this investigation.

This research study found that while women taking placenta capsules experienced a decrease in depressive symptoms within the first week postpartum, and decreased fatigue across the early postpartum period that were not experienced by women taking the placebo capsules, support was not found for other benefits that reportedly result from placentophagy such as improved maternal bonding, and increased breastmilk production. This dissertation study also found that although changes in levels of the hormones prolactin, estradiol, and progesterone were similar in both groups across the postpartum study period, women taking the placenta capsules had lower salivary progesterone at the final meeting during the third week postpartum than those taking the placebo capsules, suggesting a possible role for placenta supplements in decreasing progesterone levels.

In addition to the psychological and physiological effects noted, this study also found that placenta capsules prepared from placental tissue that has been steamed, dehydrated, and pulverized, does in fact retain detectable concentrations of many hormones and micronutrients. This dissertation also revealed that concentrations of potentially harmful environmental elements, when detected, were very low and present in concentrations that are well below established safety thresholds.

Significance and Implications

While placentophagy has been well studied in experimental animal models, there has been a lack of extensive research on the topic in human mothers. Because the popularity of the practice appears to be growing among mothers in industrialized countries, questions about the efficacy and objectively measurable effects of placentophagy, in addition to the potential risks of the practice, leave these women with little data to inform their decision to ingest their placenta during this sensitive postpartum period. This dissertation study represents a first step in addressing claims that placentophagy provides benefits for postpartum maternal affect, fatigue, and general postpartum recovery, as well as evaluating whether potentially beneficial or harmful substances can be found in placenta capsules.

In addition to contributing to the scientific literature on human maternal placentophagy, postpartum emotional and physiological changes, and human behavior in general, this research provides information about the effects of placentophagy on postpartum affect and recovery that can be useful for pregnant and postpartum women who are considering placentophagy. The results presented here can equip women and their health care providers with scientific data on the practice and aid them in making an informed decision about placentophagy, rather than relying on anecdotal evidence and data extrapolated from animal models. It is clear from the passionate support by advocates and the anecdotal reports in the literature that many women who engage in this practice experience benefits that they attribute to placentophagy. The findings presented here neither strongly support nor refute some of the most regularly cited purported benefits of placentophagy for postpartum health and recovery. Nor do the findings of the current rule out the possibility that many of the effects of placentophagy reported by women who have engaged in the practice are, at least in part, the result of a placebo effect. This is not to say that if

placentophagy elicits a placebo effect it is not a beneficial option for postpartum mothers, as placebo effects are widely recognized for their therapeutic value.

Future Research

As the practice of human maternal placentophagy continues to grow in popularity, it will become increasingly important to evaluate the claims that placentophagy provides postpartum benefits to the mother, as well as the potential risks of the practice. This dissertation encompasses only a fraction of the research that is needed to adequately address questions of the efficacy and safety of placentophagy, and future research is critical in addressing these questions.

One area of additional exploration that would nicely complement this study is an investigation into additional measures of postpartum affect, health, and recovery not addressed in this study (e.g., stress, anxiety, postpartum hemorrhage, etc.), and the relationship between other hormones and nutrients found in dehydrated capsules and women's postpartum experience. Furthermore, because accounts of contemporary placentophagy are relatively recent and the practice has only begun to gain popularity among more "mainstream" mothers over the last decade or so, no data exist on the potential long term effects of the practice for the mother or her offspring. This is an important area of research that warrants future investigation. Additional areas of future placentophagy research include detailed ethnography on the practice to identify women's motivations, beliefs about, and experiences with placentophagy. Given that this practice has become increasingly popular despite a lack of support in the scientific literature or from medical practitioners, investigations into women's decision-making process about health related issues during this reproductively sensitive time are also important. Another area ripe for scientific investigation is toxicological research to identify whether environmental contaminants

in other social, economic, and ecological contexts (including additional toxins not addressed here), are present in various preparations of human placenta, and if so, the resulting health effects of placentophagy in such circumstances. Finally, given the ubiquity of maternal placentophagy among eutherian mammals – including our closest primate relatives – investigations into evolutionary explanations for the disappearance of the behavior in our species are clearly warranted.

This dissertation contributes to a small but growing literature on the topic of human maternal placentophagy, and helps inform discussions about the potential benefits, and risks of engaging in this practice during the postpartum period. While further research is certainly necessary to advance our knowledge in this area, the information presented here lays an important foundation for future studies on the effects of human maternal placentophagy, and can inform future scientific investigation of the practice.

Appendix A: Table 2.1

Table 2.1
Recorded Placentophagy in Non-Human Primate Species (from Young et al., 2012)

Family	Species	Captive/Wild	References
Cheirogaleidae	Lesser Mouse Lemur (*Microcebus Murinus*)	Captive	in Hayssen et al., 1993
Lemuridae	Black lemurs (*Lemur macaco macaco*)	Captive	in Hayssen et al., 1993
	Ringtailed lemurs (*Lemur catta*)	Free-ranging	Sauther, 1991
	Ruffed lemurs (*Varecia variegata*)	Captive	in Hayssen et al., 1993
Indriidae	Malagasy prosimians (*Propithecus verreauxi*)	Free-ranging	Richard, 1976
	Sifaka (*Propithecus verreauxi coquereli)*	Captive	in Hayssen et al., 1993
Lorisidae	Slender loris (*Loris tardigradus lydekkerianus*)	Captive	in Hayssen et al., 1993; Kadam & Swayamprabha, 1980
Galagidae	Lesser Bushbaby (*Galago senegalensis moholi*)	Captive	in Hayssen et al., 1993
Callitrichidae	Common marmoset (*Calthrix jacchus jacclius*)	Captive	in Hayssen et al., 1993; Stevenson, 1976
	Cotton-top tamarin (*Saguinus oedipus*)	Captive	Price, 1990
	Red-bellied tamarin (*Saguinus labiatus*)	Captive	Pryce, Abbott, Hodges & Martin, 1988
Callimiconidae	Goeldi's monkey (*Callimico goeldii*)	Captive	in Hayssen et al., 1993
Cebidae	Squirrel monkeys (*Saimiri sciurea*)	Captive	in Hayssen et al., 1993; Hopf, 1967; Takeshita, 1961
Aotidae	Owl monkey (*Aotus trivirgatus*)	Captive	in Hayssen et al., 1993
Cercopithecidae	Gelada baboon (*Theropitehcus gelada*)	Wild	Dunbar & Dunbar, 1974
	Japanese macaque (*Macaca fuscata*)	Wild	Thomsen & Soltis, 2000
	Japanese macaque (*Macaca fuscata*)	Free-ranging	Turner et al., 2010
	Japanese macaque (*Mucaca fuscata*)	Captive	Negayama, Negayama &Kondo, 1986
	Java macaque (*Macaca fascicularis*)	Captive	Kemps & Timmermans, 1982; Timmermans & Vossen, 1996
	Mona monkey (*Cercopithecus mona*)	Captive	Takeshita, 1961
	Olive baboon (*Papio anubis*)	Feral	Nash, 1974
	Patas monkeys (*Erythrocebus patas*)	Captive	Hemmalin & Loy, 1989
	Proboscis monkeys (*Nasalis larvatus*)	Wild	Gorzitze, 1996
	Rhesus monkey (*Macacus rhesus*)	Captive	Adachi, Saito & Tanioka, 1982; Brandt & Mitchell, 1973; Tinklepaugh & Hartman, 1930
	Stumptail macaques (*Maeaea aretoides*)	Captive	Gouzoules, 1974
	Toque macaque (*Macaca sinica*)	Wild	Ratnayeke & Dittus, 1989
	Yellow baboon (*Papio cynocephalus*)	Wild	Condit & Smith, 1994
Atelidae	Black and gold howler monkeys (*Alouatta caraya*)	Wild	Peker, Kowalewski, Pave & Zunino, 2009
	Howler Monkeys (*Alouatta seniculu*)	Free-ranging	Sekulic, 1982
	Howler monkeys (*Alouatta seniculus*)	Free-ranging	Sekulic, 1982

	Mantled howling monkey (*Alouatta palliata*)	Wild	Moreno, Salas & Glander, 1991
	Mexican mantled howler monkeys (*Alouatta palliata*)	Semi-free-ranging	Dias, 2005
	Red-handed howler monkey (*Alouatta belzebul*)	Free-ranging	Camargo & Ferrari, 2007
Hyolbatidae	Gibbon (*Hyolbates*)	Captive	Hooton, 1946
	Muller's Bornean gibbon (*Hylobates lar mulleri*)	Captive	in Hayssen et al., 1993
	Pileated gobbon (*Hylobates lar pileatus*)		in Hayssen et al., 1993
Pongidae	Bonobo (*Pan paniscus*)	Captive	Bloser & Savage-Rumbaugh, 1989; in Hayssen et al., 1993
	Chimpanzee (*Pan troglodytes schweinfurthii*)	Free-ranging	Goodall & Athumani, 1980: in Hayssen et al., 1993
	Chimpanzee (*Pan troglodytes*)	Captive	Elder & Yerkes, 1936
	Lowland gorilla (*Gorilla gorilla gorilla*)	Captive	Beck, 1984; in Hayssen et al., 1993
	Mountain gorilla (*Gorilla gorilla beringei*)	Wild	Stewart, 1977; Stewart, 1984
	Orangutan (*Pongo poygmaeus*)	Captive	in Hayssen et al., 1993

Appendix B: Table 5.4

Table 5.4
Mean concentration of 17 hormones in samples of dehydrated placenta, beef, and vegetarian meat substitute

Capsule Contents	Hormone	Number of Detects	Concentration Range (ng/g)	Concentration Means ± SD (ng/g)
Placenta (N=28)	11-Deoxycortisol	28	15.180 – 121.092	52.305 ± 4.16
	17-hydroxyprogesterone	28	82.762 – 1105.969	265.611 ± 37.45
	7-keto DHEA	28	9.027 – 47.864	22.208 ± 1.899
	Aldosterone	28	0.179 – 2.993	1.274 ± 0.151
	Allopregnanolone	28	37.898 – 181.745	111.147 ± 7.817
	Androstenedione	28	97.501 – 1134.326	365.95 ± 40.002
	Corticosterone	28	2.183 – 59.345	15.237 ± 2.432
	Cortisol	28	9.829 – 205.696	85 ± 0.01
	Cortisone	28	356.662 – 2171.952	1196 ± 0.074
	DHEA	28	35.353 – 288.729	84.795 ± 9.67
	DHT	0	<LOD	<LOD
	Estradiol	28	44.612 – 172.959	103.46 ± 6.321
	Estriol	28	453.480 – 926.433	752.187 ± 23.047
	Estrone	28	172.527 – 582.218	343.472 ± 18.757
	Melatonin	9	0.163 – 0.494	0.14 ± 0.026
	Progesterone	28	4307.218 – 15508.879	11314.029 ± 393.895
	Testosterone	28	5.078 – 119.290	30.503 ± 4.275
Capsule Contents	**Hormone**	**Number of Detects**	**Concentration Range (ng/g)**	**Concentration Means ± SD (ng/g)**
Beef (N=3)	11-Deoxycortisol	3	0.181 - 0.950	0.668 ± 0.423
	17-hydroxyprogesterone	2	0.008 - 0.128	0.053 ± 0.065
	7-keto DHEA	0	<LOD	<LOD
	Aldosterone	0	<LOD	<LOD
	Allopregnanolone	0	<LOD	<LOD
	Androstenedione	3	0.089 - 0.273	0.182 ± 0.092
	Corticosterone	3	0.529 - 2.651	1.411 ± 1.105
	Cortisol	3	9.189 - 19.071	13.373 ± 5.112
	Cortisone	3	1.714 - 3.178	2.370 ± 0.744
	DHEA	3	0.573 - 0.945	0.726 ± 0.195
	DHT	0	<LOD	<LOD
	Estradiol	0	<LOD	<LOD
	Estriol	0	<LOD	<LOD
	Estrone	0	<LOD	<LOD
	Melatonin	3	0.020 - 0.030	0.026 ± 0.005

	Progesterone	3	0.338 - 1.627	0.972 ± 0.645
	Testosterone	3	0.026 - 0.041	0.032 ± 0.007
Capsule Contents	**Hormone**	**Number of Detects**	**Concentration Range (ng/g)**	**Concentration Means ± SD (ng/g)**
Vegetarian Meat Substitute (N=3)	11-Deoxycortisol	0	<LOD	<LOD
	17-hydroxyprogesterone	0	<LOD	<LOD
	7-keto DHEA	0	<LOD	<LOD
	Aldosterone	0	<LOD	<LOD
	Allopregnanolone	3	3.593 - 7.874	5.599 ± 2.153
	Androstenedione	3	0.197 - 0.292	0.246 ± 0.048
	Corticosterone	0	<LOD	<LOD
	Cortisol	0	<LOD	<LOD
	Cortisone	0	<LOD	<LOD
	DHEA	0	<LOD	<LOD
	DHT	0	<LOD	<LOD
	Estradiol	0	<LOD	<LOD
	Estriol	0	<LOD	<LOD
	Estrone	0	<LOD	<LOD
	Melatonin	0	<LOD	<LOD
	Progesterone	3	3.189 - 5.105	3.997 ± 0.993
	Testosterone	0	<LOD	<LOD

Appendix C: Table 5.6

Table 5.6
Mean concentration of 14 elements in samples of dehydrated placenta, beef, and vegetarian meat substitute

Capsule Contents	Element	Number of Detects	Number <LOD	Concentration Range (ppm)	Concentration Means ± SD (ppm)
Placenta (N=28)	As	28	0	0.02 - 0.07	0.032 ± 0.013
	Cd	28	0	0.01 - 0.04	0.02 ± 0.006
	Co	28	0	0.01 - 0.19	0.035 ± 0.033
	Cu	28	0	3.30 - 7.81	5.583 ± 1.139
	Fe	28	0	440.86 - 1185.18	664.382 ± 161.398
	Pb	28	0	0.01 - 0.1	0.048 ± 0.023
	Mn	28	0	0.33 - 1.95	0.749 ± 0.444
	Hg	24	4	0 - 0.05	0.012 ± 0.013
	Mo	28	0	0.02 - 0.04	0.029 ± 0.004
	Rb	28	0	4.23 - 12.14	8.029 ± 1.931
	Se	28	0	1.16 - 2.48	1.509 ± 0.271
	Sr	28	0	0.73 - 24.21	4.47 ± 4.223
	U	28	0	0 - 0.03	0.009 ± 0.006
	Zn	28	0	40.65 - 63.59	54.635 ± 5.602
Capsule Contents	**Hormone**	**Number of Detects**	**Number <LOD**	**Concentration Range (ppm)**	**Concentration (ppm)**
Beef (N=1)	As	1	0	N/A	0.021
	Cd	1	0	N/A	0.001
	Co	1	0	N/A	0.007
	Cu	1	0	N/A	3.662
	Fe	1	0	N/A	92.884
	Pb	1	0	N/A	0.004
	Mn	1	0	N/A	0.297
	Hg	1	0	N/A	<0.010
	Mo	1	0	N/A	0.022
	Rb	1	0	N/A	20.583
	Se	1	0	N/A	0.218
	Sr	1	0	N/A	0.233
	U	1	0	N/A	0.006
	Zn	1	0	N/A	170.201
Capsule Contents	**Hormone**	**Number of Detects**	**Number <LOD**	**Concentration Range (ppm)**	**Concentration (ppm)**
Vegetarian Meat Substitute (N=1)	As	1	0	N/A	0.014
	Cd	1	0	N/A	0.002
	Co	1	0	N/A	0.011
	Cu	1	0	N/A	13.260

	Fe	1	0	N/A	15.382
	Pb	1	0	N/A	0.017
	Mn	1	0	N/A	136.840
	Hg	1	0	N/A	<0.010
	Mo	1	0	N/A	0.091
	Rb	1	0	N/A	0.968
	Se	1	0	N/A	0.121
	Sr	1	0	N/A	4.523
	U	1	0	N/A	0.013
	Zn	1	0	N/A	203.427

Appendix D: Background Information and Meeting 1 Questionnaire

An Investigation of the Effects of Human Maternal Placentophagy in Postpartum Maternal Health and Recovery
University of Nevada, Las Vegas

Please answer the following questions as accurately as possible

Age: _____ Height: _____ ft _____ in Weight: _____ lbs

With which ethnicity do you most closely identify?

__ American Indian/Alaska Native __ Caucasian __ Middle Eastern
__ Asian __ Hispanic/Latina __ Other _____
__ African American __ Hawaiian/Pacific Islander

What is the highest level of education you have completed?

__ Grammar School __ Bachelor's degree __ Doctoral degree
__ High School or equivalent __ Master's degree __ Professional degree (MD, JD, etc.)
__ Some college __ Vocational/technical school

Which of the following income groups includes your total annual family income:

__ Under $10,000 __ $30,001—$40,000 __ $60,001—$70,000
__ $10,000—$20,000 __ $40,001—$50,000 __ $70,001—$80,000
__ $20,001—$30,000 __ $50,001—$60,000 __ Over $80,000

Please indicate your marital status:

__ Single, never married __ Married or domestic partnership
__ Separated __ In a committed relationship, not cohabiting
__ Divorced __ Widowed

Total number of people in the household: _____

Zip Code: _____

Are you currently employed outside of the home? Yes No

Do you currently consume alcoholic beverages? Yes No

If yes, how often (circle one)? daily frequently occasionally rarely

Do you currently smoke cigarettes? Yes No

Was your current pregnancy planned? Yes No

Thinking back to just before you became pregnant, when would you say that you wanted to be pregnant (circle one)? Sooner Later At that time Never

When you first realized you were pregnant, what was your reaction (circle one)?

Very Happy Somewhat Happy Neither Happy nor Unhappy Somewhat Unhappy Very Unhappy

In the 3 months before your most recent pregnancy, did you take a multivitamin containing folic acid or a folic acid supplement?

No Rarely Occasionally Almost everyday Daily

Is this your first pregnancy? Yes No

If this is not your first pregnancy, how many times have you given live birth? _____

How old are your children? _____

Did you have complications with any of your pregnancies? Yes No

If yes, please explain briefly:

_____

_____

Have you ever ingested placenta, in any form, after any of your pregnancies? Yes No

If yes, after which pregnancy did you ingest placenta? _____

Did you experience any effects that you attributed to placentophagy? Yes No

Please describe:

_____

_____

_____

Do you have any chronic health conditions? Yes No

If yes, please describe them here:

_____

_____

Please mark any of the following conditions that you have experienced, and indicate the severity and whether the condition was diagnosed by a medical professional:

___	Depression	Mild	Moderate	Severe	___	Diagnosed
___	Antenatal (pregnancy) depression	Mild	Moderate	Severe	___	Diagnosed
___	Postnatal depression	Mild	Moderate	Severe	___	Diagnosed
___	Maternity blues	Mild	Moderate	Severe	___	Diagnosed
___	Premenstrual dysphoric disorder (PMDD)	Mild	Moderate	Severe	___	Diagnosed
___	Anxiety	Mild	Moderate	Severe	___	Diagnosed
___	Bipolar disorder	Mild	Moderate	Severe	___	Diagnosed
___	Schizophrenia	Mild	Moderate	Severe	___	Diagnosed
___	Anemia	Mild	Moderate	Severe	___	Diagnosed
___	Insomnia/sleep disorder	Mild	Moderate	Severe	___	Diagnosed
___	Thyroid disorder	Mild	Moderate	Severe	___	Diagnosed
___	Endocrine disorder	Mild	Moderate	Severe	___	Diagnosed
___	Reproductive disorder (e.g., PCOS, endometriosis)	Mild	Moderate	Severe	___	Diagnosed

Are you currently consuming a special diet (e.g., vegan, vegetarian, etc.)? Yes No

If yes, please explain:

_____

Did your diet changed after learning that you were pregnant? Yes No

If yes, please explain how?

_____

_____

_____

How much has your diet changed since pre-pregnancy (circle one)?

drastically moderately minimally none

Are you currently taking any medication? Yes No

If yes, please list the medication you are taking:

_____

_____

_____

Are you currently taking any nutritional supplements (including multivitamins): Yes No

If yes, please list them here, and indicate the brand and dose:

_____

_____

_____

What is the starting date of your last menstrual period (MM/DD/YY)? _____/_____/_____

What is your projected due date (MM/DD/YY)? _____/_____/_____

Where do you plan to give birth?

__ In a hospital with a physician __ At home

__ In a hospital with a midwife __ At a birthing center

__ Other Please describe: _____

When did you decide that you wanted to ingest your placenta after giving birth (MM/YY)? ____/____

Why did you decide that you wanted to ingest your placenta after giving birth?

_____

_____

Section 1: Edinburgh Postnatal Depression Scale
Section 2: Kennerley Blues Questionnaire
Section 3: DASS21
Section 4: Pittsburgh Sleep Quality Index
Section 5: Fatigue Assessment Scale
Section 6: Kansas Marital Satisfaction Scale
Section 7: Prenatal Attachment Inventory
Section 8: Multidimensional Scale of Perceived Social Support

Appendix E: Meeting 2 Questionnaire

An Investigation of the Effects of Human Maternal Placentophagy in Postpartum Maternal Health and Recovery
University of Nevada, Las Vegas

Please answer the following questions as accurately as possible

Please list your height: _____ ft _____ in and weight: _____ lbs

Do you currently consume alcoholic beverages? Yes No

If yes, how often? daily frequently occasionally rarely

Do you currently smoke cigarettes? Yes No

Are you currently consuming a special diet (e.g., vegan, vegetarian, etc.)? Yes No

If yes, please explain:

_____

Are you currently taking any medication? Yes No

If yes, please list the medication you are taking:

_____

_____

_____

Are you currently taking any nutritional supplements (including multivitamins): Yes No

If yes, please list them here, and indicate the brand and dose:

_____

_____

_____

When did you give birth to your most recent child?

Date: _____/_____/_____ Time: _____ am pm

Where did you give birth?

__ In a hospital with a physician __ At home

__ In a hospital with a midwife __ At a birthing center

__ Other Please describe: _____

How much did your child weigh at birth? _____lbs _____oz

Did you receive any medical interventions during the birth (e.g., episiotomy, epidural, induced labor, etc.)? Yes No

If yes, please explain:

_____

_____

_____

Were there any complications during the birth? Yes No

If yes, please explain briefly:

_____

_____

Section 1: Edinburgh Postnatal Depression Scale
Section 2: Kennerley Blues Questionnaire
Section 3: DASS21
Section 4: Pittsburgh Sleep Quality Index
Section 5: Fatigue Assessment Scale
Section 6: Kansas Marital Satisfaction Scale
Section 7: Mother-to-Infant Bonding Scale
Section 8: Multidimensional Scale of Perceived Social Support

Section 9: In the chart below, please indicate how each item has changed since the last few weeks of pregnancy.

	Improved	**Stayed the Same**	**Worsened**
Energy	☐	☐	☐
Anxiety	☐	☐	☐
Stress	☐	☐	☐
Strength	☐	☐	☐
Sleep quality	☐	☐	☐
Libido	☐	☐	☐
Attachment to your baby	☐	☐	☐
Overall health	☐	☐	☐
Overall mood	☐	☐	☐

Appendix F: Meetings 3 and 4 Questionnaire

An Investigation of the Effects of Human Maternal Placentophagy in Postpartum Maternal Health and Recovery
University of Nevada, Las Vegas

Please answer the following questions as accurately as possible

Please list your height: _____ ft _____ in and weight: _____ lbs

Do you currently consume alcoholic beverages? Yes No

If yes, how often? daily frequently occasionally rarely

Do you currently smoke cigarettes? Yes No

Are you currently consuming a special diet (e.g., vegan, vegetarian, etc.)? Yes No

If yes, please explain:

_____

Are you currently taking any medication? Yes No

If yes, please list the medication you are taking:

_____

_____

_____

Are you currently taking any nutritional supplements (including multivitamins): Yes No

If yes, please list them here, and indicate the brand and dose:

_____

_____

_____

Section 1: Edinburgh Postnatal Depression Scale
Section 2: Kennerley Blues Questionnaire
Section 3: DASS21
Section 4: Pittsburgh Sleep Quality Index
Section 5: Fatigue Assessment Scale
Section 6: Kansas Marital Satisfaction Scale
Section 7: Mother-to-Infant Bonding Scale
Section 8: Multidimensional Scale of Perceived Social Support

Section 9: In the chart below, please indicate how each item has changed since the day your youngest child was born, and whether you think these changes occurred as a result of taking the placenta or placebo supplement provided you in this study

				Result of taking supplement?		
	Improved	**Stayed the same**	**Worsened**	**Yes**	**No**	**Not Sure**
Energy	☐	☐	☐	☐	☐	☐
Breast milk quality	☐	☐	☐	☐	☐	☐
Breast milk quantity	☐	☐	☐	☐	☐	☐
Postpartum bleeding	☐	☐	☐	☐	☐	☐
Anxiety	☐	☐	☐	☐	☐	☐
Stress	☐	☐	☐	☐	☐	☐
Strength	☐	☐	☐	☐	☐	☐
Sleep quality	☐	☐	☐	☐	☐	☐
Libido	☐	☐	☐	☐	☐	☐
Bonding with your infant	☐	☐	☐	☐	☐	☐
Overall health	☐	☐	☐	☐	☐	☐
Overall mood	☐	☐	☐	☐	☐	☐
General recovery	☐	☐	☐	☐	☐	☐

Did you experience any other changes not listed here? Yes No

If yes, please describe them here:

_____

_____

_____

Do you think you received your placenta or a placebo? Placenta Placebo

Why? _____

_____

_____

Appendix G:

UNLV
UNIVERSITY OF NEVADA LAS VEGAS

Biomedical IRB – Full Board Review
Approval Notice

NOTICE TO ALL RESEARCHERS:
Please be aware that a protocol violation (e.g., failure to submit a modification for any change) of an IRB approved protocol may result in mandatory remedial education, additional audits, re-consenting subjects, researcher probation, suspension of any research protocol at issue, suspension of additional existing research protocols, invalidation of all research conducted under the research protocol at issue, and further appropriate consequences as determined by the IRB and the Institutional Officer.

DATE: July 23, 2013

TO: **Dr.Daniel Benyshek**, Anthropology

FROM: Office of Research Integrity - Human Subjects

RE: Notification of IRB Action
Protocol Title: **An Investigation of the Effects of Human Maternal Placentophagy on Postpartum Health and Recovery**
Protocol #: 1305-4465M
Expiration Date:July 22, 2014

This memorandum is notification that the project referenced above has been reviewed and approved by the UNLV Biomedical Institutional Review Board (IRB) as indicated in Federal regulatory statutes 45 CFR 46 and UNLV Human Research Policies and Procedures.

The protocol is approved for a period of one year and expires July 22, 2014. If the above-referenced project has not been completed by this date you must request renewal by submitting a Continuing Review Request form 60 days before the expiration date.

PLEASE NOTE:
Upon approval, the research team is responsible for conducting the research as stated in the protocol most recently reviewed and approved by the IRB, which shall include using the most recently submitted Informed Consent/Assent forms and recruitment materials. The official versions of these forms are indicated by footer which contains approval and expiration dates.

Should there be *any* change to the protocol, it will be necessary to submit a **Modification Form** through ORI - Human Subjects. No changes may be made to the existing protocol until modifications have been approved by the IRB. Modified versions of protocol materials must be used upon review and approval. Unanticipated problems, deviations to protocols, and adverse events must be reported to the ORI – HS within 10 days of occurrence.

If you have questions or require any assistance, please contact the Office of Research Integrity - Human Subjects at IRB@unlv.edu or call 895-2794.

Office of Research Integrity - Human Subjects
4505 Maryland Parkway • Box 451047 • Las Vegas, Nevada 89154-1047
(702) 895-2794 • FAX: (702) 895-0805

Appendix H:

UNLV
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Biomedical IRB – Expedited Review
Continuing Review Approved

NOTICE TO ALL RESEARCHERS:

Please be aware that a protocol violation (e.g., failure to submit a modification for any change) of an IRB approved protocol may result in mandatory remedial education, additional audits, re-consenting subjects, researcher probation suspension of any research protocol at issue, suspension of additional existing research protocols, invalidation of all research conducted under the research protocol at issue, and further appropriate consequences as determined by the IRB and the Institutional Officer.

DATE: June 19, 2014

TO: **Dr. Daniel Benyshek**, Anthropology

FROM: Office of Research Integrity – Human Subjects

RE: Notification of IRB Action
Protocol Title: **An Investigation of the Effects of Human Maternal Placentophagy on Postpartum Health and Recovery**
Protocol #: 1305-4465M
Expiration Date:June 18, 2015

Continuing review of the protocol named above has been reviewed and approved.

This IRB action will reset your expiration date for this protocol. The protocol is approved for a period of one year from the date of IRB approval. The new expiration date for this protocol is June 18, 2015. If the above-referenced project has not been completed by this date you must request renewal by submitting a Continuing Review Request form 30 days before the expiration date.

PLEASE NOTE:
Upon approval, the research team is responsible for conducting the research as stated in the protocol most recently reviewed and approved by the IRB, which shall include using the most recently submitted Informed Consent/Assent forms and recruitment materials. The official versions of these forms are indicated by footer which contains current approval and expiration dates.

Should there be *any* change to the protocol, it will be necessary to submit a **Modification Form** through ORI - Human Subjects. No changes may be made to the existing protocol until modifications have been approved by the IRB. Modified versions of protocol materials must be used upon review and approval. Unanticipated problems, deviations to protocols, and adverse events must be reported to the ORI – HS within 10 days of occurrence.

If you have questions or require any assistance, please contact the Office of Research Integrity - Human Subjects at IRB@unlv.edu or call 895-2794.

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Stewart KJ. 1977. The birth of a wild mountain gorilla (*Gorilla gorilla beringei*). Primates 18(4):965-976.

Stewart KJ. 1984. Parturition in Wild Gorillas: Behaviour of Mothers, Neonates, and Others. Folia Primatol 42:62-69.

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Young SM, Benyshek DC, and Lienard P. 2012. The Conspicuous Absence of Placenta Consumption in Human Postpartum Females: The Fire Hypothesis. Ecology of Food and Nutrition 51(3):198-217.

Young SM, Gryder LK, David WB, Teng Y, Gerstenberger S, and Benyshek DC. 2016. Human Placenta Processed for Encapsulation Contains Modest Concentrations of Fourteen Trace Minerals and Elements. Nutrition Research 36(8):872-878.

Young SM, Gryder LK, Zava D, Kimball DW, and Benyshek DC. 2016. Presence and concentration of 17 hormones in human placenta processed for encapsulation and consumption. Placenta 43:86-89.

Zimet GD, Dahlem NW, Zimet SG, and Farley GK. 1988. The Multidimensional Scale of Perceived Social Support. Journal of Personality Assessment 52(1):30-41.

Curriculum Vitae

Sharon M. Young

University of Nevada, Las Vegas
Department of Anthropology
Las Vegas, NV 89154-5003
Office Phone: (702) 895-2367
Cellular Phone: (702) 983-0386
Email: Sharon.Young@unlv.edu

EDUCATION

2010-Present Ph.D. in Anthropology, In Progress, University of Nevada, Las Vegas
Dissertation: An Investigation of the Effects of Human Maternal Placentophagy on Postpartum Affect, Health and Recovery

2007-2010 M.A. in Anthropology, University of Nevada, Las Vegas, NV
Professional Paper: In search of human placentophagy: a cross cultural survey of human placenta consumption, disposal and beliefs.

2003-2005 B.S. Anthropology, Magna Cum Laude, University of California, Riverside, CA
Senior Thesis: A comparison of *Homo floresiensis* to pygmy mammals and modern human dwarfs to determine the possibility of a dwarf species.

2000-2003 General Education, Chaffey Community College, Rancho Cucamonga, CA

RESEARCH SPECIALIZATIONS AND INTERESTS

I am a biomedical anthropologist interested in evolutionary perspectives on health and disease. My research has focused on female reproductive health and the practice of human maternal placentophagy in cross-cultural and evolutionary context. My research interests include biocultural anthropology, human reproductive ecology, women's health, human placentophagy, nutrition and diet, and evolutionary medicine.

PROFESSIONAL EXPERIENCE

2015-Present Program Manager, Office of Undergraduate Research, University of Nevada, Las Vegas

2014-2015 Part Time Instructor of Anthropology, Department of Anthropology, University of Nevada, Las Vegas

2014-2015 Graduate and Professional Student Body President, Graduate Assistant, Graduate College, University of Nevada, Las Vegas

2013-2014 Research Assistant, Harry Reid Center for Environmental Studies and Department of Geoscience, University of Nevada, Las Vegas

2012 Instructor, Summer Advanced Gifted Education (SAGE) Program, Honors College, University of Nevada, Las Vegas

2008-2012 Graduate Research Assistant, Graduate Teaching Assistant, and Part Time Instructor, Anthropology Department, University of Nevada, Las Vegas.

2008 Graduate Research Assistant, Women's Studies Department, University of Nevada, Las Vegas. January - May

2005-2007 Long Term Substitute Teacher, Summit Intermediate School, Etiwanda School District, Etiwanda, California

TEACHING EXPERIENCE

2010-2014 Instructor, Department of Anthropology, University of Nevada, Las Vegas
- Introduction to Physical Anthropology
- Introduction to Cultural Anthropology
- Anthropology of Women an d Men (co-instructed with Alyssa Crittenden)
- Physical Anthropology Laboratory

2012 Instructor, Summer Advanced Gifted Education (SAGE), Honors College, University of Nevada, Las Vegas
- People, Plants, and Animals

2008-2012 Teaching Assistant, Department of Anthropology, University of Nevada, Las Vegas
- Introduction to Cultural Anthropology
- Introduction to Physical Anthropology
- Introduction to World Archaeology
- Peoples and Cultures of Native North America
- Peoples and Cultures of Ancient Near East
- Nutritional Anthropology

RESEARCH EXPERIENCE

2008-Present	Primary student investigator for ongoing research on human maternal placentophagy, including laboratory-based placental tissue analysis, internet-based survey, experimental research with human participants, cross-cultural analysis using database and ethnographic literature sources, and double-blind placebo-controlled investigation of the effects of postpartum placenta capsule supplementation
2010-2014	Research assistant for laboratory-based experimental immunotoxicology research investigating the health effects of toxic substances and environmental contaminants using rodent models and human subjects
2010	Questionnaire administration and collection of salivary samples for hormonal analysis for human sexuality research
2005	Student researcher for literature-based senior thesis project in which limb proportions from *H. floresiensis* were compared to those of *H. erectus* and modern human dwarfs to identify whether it more closely resembles an insular erectine dwarf or modern human dwarf.
2002	Crew member for the excavation of the Historic Fallis Brothers Building in Ontario, California. Involved in excavation, artifact analysis and writing the field report. Principal Investigator, Michael Fong, Chaffey Community College.

GRANTS AND AWARDS

2015	Graduate and Professional Student Association Merit Award, GPSA at University of Nevada, Las Vegas ($300.00)
2014	Graduate and Professional Student Association Research Grant, GPSA at University of Nevada, Las Vegas ($1,250.00)
2014	University of Nevada, Las Vegas Graduate and Professional Student Association Research Forum Social Sciences Platform Presentation Competition, First Place Prize, UNLV GPSA, Las Vegas, NV ($200.00)
2013	Graduate and Professional Student Association Service Award, GPSA at University of Nevada, Las Vegas ($300.00)
2012-2014	UNLV Foundation Board of Trustees Research Fellowship, Graduate College at University of Nevada, Las Vegas ($60,000.00)
2011	Alumni Association Sterling Award, Graduate College at University of Nevada, Las Vegas ($5,000.00)
2011	Dean's Graduate Student Stipend Award, College of Liberal Arts, University of Nevada, Las Vegas ($2,000.00)

2010 Graduate and Professional Student Association Travel Grant, GPSA at University of Nevada, Las Vegas ($690.00)

2010 Patricia L. Rocchio Memorial Scholarship Fund for Anthropology, Department of Anthropology, University of Nevada, Las Vegas ($400.00)

2010 Graduate and Professional Student Association Travel Grant, GPSA at University of Nevada, Las Vegas ($580.00)

2009 Eleanor F. Edwards and Max Olswang Scholarship Fund for Anthropology – Archaeology, Department of Anthropology, University of Nevada, Las Vegas ($350.00)

2009 University of Nevada, Las Vegas Graduate and Professional Student Association Research Forum Social Sciences Poster Competition, Second Place Prize, UNLV GPSA, Las Vegas, NV ($125.00)

2009 Graduate and Professional Student Association Research Grant, GPSA at University of Nevada, Las Vegas ($750.00)

2005 Senior Thesis Research Grant, Office of Undergraduate Research at the University of California, Riverside ($400.00)

2005 Mary G. and Rawley J. Miller Scholarship for Academic Achievement, Department of Anthropology, Chaffey Community College, Rancho Cucamonga, CA ($5,000.00)

2003-2005 Dean's List, University of California, Riverside, CA

2002-2003 Dean's List, Chaffey Community College, Rancho Cucamonga, CA

PUBLICATIONS

Peer Reviewed Journal Articles:

In Press Gryder K., **Young S.M.**, Zava D., Kimball D., Cross C., and Benyshek D.C. Effects of Human Maternal Placentophagy on Maternal Postpartum Iron-Status: A Randomized, Double Blind, Placebo Controlled Pilot Study. Submitted to *Journal of Midwifery and Women's Health.*

2016 **Young S.M.**, Gryder K., Zava D., Kimball D., and Benyshek D.C. Presence and Concentration of 17 Hormones in Human Placenta Processed for Encapsulation and Consumption. Prepared for submission to *Placenta* 43:86-89.

2016 **Young, S.M.**, Gryder, L.K., David, W.D., Teng, Y., Gerstenberger, S., and Benyshek, D.C. Human Placenta Processed for Encapsulation Contains Modest Concentrations of Fourteen Trace Minerals and Elements. *Nutrition Research* 36(8):872-878.

2016 DeWitt, J. Buck, B., Goossens, D., Hu, Q., Chow, R., David, W.B, **Young, S.M.**, Teng, Y., Leetham-Spencer, M., Murphy, L., Pollard, J., McLaurin, B., Gerads, R., Keil, D. Health effects following subacute exposure to geogenic dusts from arsenic-rich sediment at the Nellis Dunes Recreation Area, Las Vegas, NV. *Toxicology and Applied Toxicology* 304: 79-89.

2013 Selander, J., Cantor, A., **Young, S.M.**, and Benyshek, D.C. Human Maternal Placentophagy: A Pilot Study Examining Postnatal Experiences with Placenta Consumption. *Ecology of Food and Nutrition*, 52(2): 93-115.

2012 **Young, S.M.**, Benyshek, D.C., and Lienard, P. The conspicuous absence of placenta consumption in human postpartum females: The fire hypothesis. *Ecology of Food and Nutrition*, 51(3): 198-217.

2011 Gray, P.B., and **Young, S.M.** A cross-cultural perspective on human-pet dynamics. *Anthrozoos*, 24(1): 17-30.

2010 **Young, S.M.**, and Benyshek D.C. In search of human placentophagy: a cross cultural survey of human placenta consumption, disposal and beliefs. *Ecology of Food and Nutrition*, 49(6): 467-484.

Book Chapters

2013 Escasa, M., **Young, S.M.** and Gray, P.B. Now or later: Peripartum shifts in female sociosexuality. In *Evolution's Empress: How Females Shape Human Adaptation*, Fisher, M., Garcia, J., Sokol Chang, R., Strout, S.L., eds. Oxford University Press: Oxford, UK.

Non-Refereed Publications and Government Reports:

2014 Buck, B., Goossens, D., McLaurin, B., Teng, Y., Pollard, J., Taylor, W., **Young, S.**, David, W., and Gerads, R. Chapter 5: Arsenic and other analytes in the Nellis Dunes Recreation Area: occurrence, distribution, and origin. In: *Nellis Dunes Recreation Area: Dust Exposure and Human Health Risk Assessment*, B.J. Buck, D. Keil, D. Goossens, J. DeWitt, and B. McLaurin (Eds.), Final Report to Bureau of Land Management for Task Agreement Number L11AC20058. September 2014, pp. 101-165.

2014 Keil, D.K, DeWitt, J., Spencer, M., Murphy, L., David, W., Chow, R., **Young, S.**, Hu, Q., Eggers, M., Gerads, R., Goossens, D., and Buck, B. Chapter 10: Immunotoxicological and neurotoxicological effects of subacute exposure to CBN 1 dust samples. In: *Nellis Dunes Recreation Area: Dust Exposure and Human Health Risk Assessment*, B.J. Buck, D. Keil, D. Goossens, J. DeWitt, and B. McLaurin (Eds.), Final Report to Bureau of Land Management for Task Agreement Number L11AC20058. September 2014, pp. 233-276.

2014 Keil, D.K, DeWitt, J., Hu, Q., David, W., Chow, R., **Young, S.**, Spencer, M., Murphy, L., Teng, Y., Goossens, D., and Buck, B. Chapter 11:

Immunotoxicological and neurotoxicological effects of subacute exposure to CBN 2 dust samples. In: *Nellis Dunes Recreation Area: Dust Exposure and Human Health Risk Assessment*, B.J. Buck, D. Keil, D. Goossens, J. DeWitt, and B. McLaurin (Eds.), Final Report to Bureau of Land Management for Task Agreement Number L11AC20058. September 2014, pp. 277-294.

2014 Keil, D.K., DeWitt, J., Goossens, D., Hu, Q., Spencer, M., Murphy, L., David, W., Eggers, M., Chow, R., **Young, S.**, Teng, Y., and Buck, B. Chapter 15: Immunotoxicological and neurotoxicological effects of subacute exposure to CBN 6 dust samples. In: *Nellis Dunes Recreation Area: Dust Exposure and Human Health Risk Assessment*, B.J. Buck, D. Keil, D. Goossens, J. DeWitt, and B. McLaurin (Eds.), Final Report to Bureau of Land Management for Task Agreement Number L11AC20058. September 2014, pp. 343-358.

2014 Keil, D.K, Goossens, D., Buck, B., DeWitt, J., Teng, Y., David, W., Chow, R., and **Young, S**. Chapter 19: Dust exposure during ORV recreation in the Nellis Dunes recreation Area: human exposure pilot study. In: *Nellis Dunes Recreation Area: Dust Exposure and Human Health Risk Assessment*, B.J. Buck, D. Keil, D. Goossens, J. DeWitt, and B. McLaurin (Eds.), Final Report to Bureau of Land Management for Task Agreement Number L11AC20058. September 2014, pp. 413-433.

2010 Buck, B.J., Goossens, D., McLaurin, B., Soukup, D., Keil, D., Teng, Y., Sudowe, R., Proper, S., Peden-Adams, M., Ayala, N., Berger-Ritchie, J., Lebahn, S., **Young, S.**, Baron, D., and Roman, A. Measuring Dust Emissions, Chemistry, and Mineralogy to Assess, Predict, and Manage Natural and Disturbed Land Surfaces, Nellis Dunes Recreation Area, Nevada. In: *Research on Arid Soils in Southern Nevada: Dust Emissions, Petrocalcic Genesis, Petrogypsic Soils, and Biological Soil Crusts*, B.J. Buck, D. Merkler, and S. Thai (Eds.), Fieldtrip Guidebook for Western Regional Cooperative Soil Survey, Western Society of Soil Science/Western Society of Crop Science Joint Conference, Las Vegas, Nevada: June 21-24, 2010, pp. 5-33.

2010 Keil, D.E., Proper, S., Peden-Adams, M., Ayala, N., Berger-Ritchie, J., Lebahn, S., **Young, S.**, Buck, B., Goossens, D., Soukup, D., Sudowe, R., Teng, Y., Baron, D. Immunotoxicological Health Effects of Acute Exposure to Dust Samples Collected from Nellis Dunes Recreational Area. In: *Research on Arid Soils in Southern Nevada: Dust Emissions, Petrocalcic Genesis, Petrogypsic Soils, and Biological Soil Crusts*, B.J. Buck, D. Merkler, and S. Thai (Eds.), Fieldtrip Guidebook for Western Regional Cooperative Soil Survey, Western Society of Soil Science/Western Society of Crop Science Joint Conference, Las Vegas, Nevada: June 21-24, 2010, pp. 27-33.

Articles and Works in prep and under review:

In Prep Benyshek, D.C., and **Young, S.M.** *Consuming the Placenta: The Evolutionary Foundations of Placentophagy*. Cambridge University Press: Cambridge, UK.

ORGANIZED SYMPOSIA

2011 Co-organizer of an invited symposium: *Mothers, Children and Others: Anthropological Perspectives on Health at the Margins* Southwestern Anthropological Association Annual Conference, May 5th – 8th, Reno, NV.

2010 Co-organizer of a Society for Food and Nutrition (SAFN) and Biological Anthropology Society (BAS) jointly sponsored invited symposium: *Human Consumption of 'Afterbirth' (Maternal Placentophagy): A 'Natural' and Beneficial Practice?* 109th Annual meeting of the American Anthropological Association, November 17th – 21st, New Orleans, LA.

PRESENTATIONS AND INVITED TALKS

Professional Conferences and Academic Forums

2015 **Young, S.M.** *Strange Medicine: The Effects of Placenta Supplements on Postpartum Affect and Recovery* 114th Annual Meeting of the American Anthropological Association, Denver, CO, November 19th – 22nd (invited talk)

2014 Benyshek, D.C., and **Young, S.M.** *The emerging trend of human maternal placentophagy: can placenta consumption enhance mother-infant bonding?* 113th Annual Meeting of the American Anthropological Association, Washington, D.C., December 3rd – 7th (invited talk)

2014 Buck, B., Keil, D., Goossens, D., DeWitt, J., Warren, A., Simon, T., McLaurin, B., Teng, Y., David, W., Morman, S., Eggers, M., Leetham-Spencer, M., Murphy, L., and **Young, S**. *Human Health Risk Assessment of Mineral Dust Exposure, Nellis Dunes Recreation Area, NV, USA* 2014 International Annual Meeting of the Soil Science Society of America, Long Beach, CA, November 2nd – 5th (presented by Brenda Buck)

2014 **Young, S.M.**, and Benyshek, D.C. *Assessing the risks of maternal placentophagy: An analysis of environmental metals in human placenta capsules* 82nd Meeting of the American Association of Physical Anthropology, Calgary, Alberta, Canada, April 9th – 12th, poster presentation

2014 Gryder, L., **Young, S.M.**, Liénard, P., and Benyshek, D.C. *Exploring the human exception to maternal placentophagy among mammals: Assessing the visual and olfactory aversion to human placental tissue* 82nd Meeting of the American Association of Physical Anthropology, Calgary, Alberta, Canada, April 9th – 12th, poster presentation (presented by Laura Gryder)

2014 Leetham-Spencer, M., DeWitt, J.C., Peden-Adams, M.M., Chow, R.M., David, W.B., Murphy, L.T., Jensen, M., Walters, N., Gryder, L., Buck, BJ., Goossens, D., Teng, Y., **Young, S.**, and Keil, D.E. *Immunotoxicity Profile following Exposure to Geological Dust Samples Collected from Nellis Dunes Recreational*

Area Map Unit CBN2: Median Grain Size 4.5 μm 53rd Annual Meeting of the Society of Toxicology, Phoenix, AZ, March 24th-27th, poster presentation (presented by Mallory Leetham-Spencer)

2014 Murphy, L.T., David, W.B., Chow, R.M., Spencer, M., Jensen, M., Buck, B.J., Goossens, D., Teng, Y., Gryder, L., **Young, S.**, Walters, N., Keil, D.E., Peden-Adams, M.M., and Dewitt, J.C. *Immunotoxicity Profile following Exposure to Silt Deposit Dust Samples from Nellis Dunes Recreational Area, Clark County, Nevada* 53rd Annual Meeting of the Society of Toxicology, Phoenix, AZ, March 24th-27th, poster presentation (presented by Lacey Murphy)

2012 **Young, S.M.**, Escasa, M., and Gray, P.B. *Shifts in female Sociosexuality during the Peripartum Period* 24th Annual Meeting of the Human Behavior and Evolution Society, Albuquerque, NM, June 13th – 17th

2012 **Young, S.M.**, Selander, J., Cantor, A., and Benyshek, D.C. *Maternal Experiences with Postnatal Placentophagy* Society for Cross Cultural Research Annual Conference, Las Vegas, NV, February 22nd-25th
Session Chair, *Women, Children, and Health: Selected Topics*

2011 **Young, S.M.** *Human Placenta as Maternal Medicine: Are there Risks to Consider?* Southwestern Anthropological Association Conference, Reno, NV, May 5th -8th

2011 Gray, P.B., Escasa, M. and **Young, S.M.** *Peripartum Shifts in Female Sociosexuality* American Association of Physical Anthropology Meetings, Minneapolis, MN, April 12th-16th

2011 **Young, S.M.**, and Gray, P.B. *Human Pet Relationships in Cross-Cultural Perspective* University of Nevada, Las Vegas Graduate and Professional Student Association Research Forum, Las Vegas, NV, March 6th – 10th, poster presentation

2011 Proper, S.P., Peden-Adams, M., Ayala, N., Berger-Ritchie, J., Lebahn, S., **Young, S.**, Buck, B., Goossens, D., Soukup, D., Sudowe, R., Teng, Y., Baron, D., Harkema, J.R. and Keil, D.E. *Health Effects Due to Acute Exposure of Dust Samples Collected from Nellis Dunes Recreational Area* 50th Annual Meeting of the Society of Toxicology, Washington D.C., March 6th – 10th, poster presentation (presented by Steve Proper)

2011 Peden-Adams, M., Berger-Ritchie, J., **Young, S.**, Ayala, N., and Keil, D. *The Role of T-cell IL-2 and Macrophage IL-10 Production in PFOS-Induced Humoral Immunosupression* Society of Toxicology Annual Meeting, Washiungton D.C., March 2011, poster presentation (presented by Margie Peden-Adams)

2010 **Young, S.M.**, Cantor, A., Liénard, P., and Benyshek, D.C. *Revulsion or Appeal? A Blind Test of the Visual and Olfactory Cues of Human Placental Tissue*

American Anthropological Association Conference, New Orleans, LA, November 17th -21st

2010 Benyshek, D.C., **Young, S.M.**, and Selander, J. *Eating the Placenta: How do the Nutritional and Hormonal Profiles of Unprepared Human Placental Tissue Compare with Processed Human placental Capsules?* American Anthropological Association Conference, New Orleans, LA, November 17th -21st (presented by Daniel C. Benyshek)

2010 Selander, J., Cantor, A., **Young, S.M.**, and Benyshek, D.C. *Human Maternal Placentophagy: Benefits for Postpartum Mothers* American Anthropological Association Conference, New Orleans, LA, November 17th -21st (presented by Jodi Selander)

2010 Liénard, P., **Young, S.M.**, and Benyshek, D.C. *Disgust, Habit, or…? The 'Evolution' of an Avoidance* American Anthropological Association Conference, New Orleans, LA, November 17th -21st (presented by Pierre Liénard)

2010 Escasa, M., **Young, S.M.**, and Gray, P.B. *Peripartum Shifts in Female Sociosexuality* American Anthropological Association Conference, New Orleans, LA, November 17th -21st, poster presentation, (presented by Michelle Escasa)

2010 **Young, S.M.**, and Gray, P.B. *Pets in Cross-Cultural Perspective* Human Behavior and Evolution Society Conference, Eugene, OR, June 16th – 20th, poster presentation

2010 **Young, S.M.**, and Benyshek, D.C. *Human Placenta: From Biohazard to Food and Medicine for Mom* Society for the Anthropology of Food and Nutrition Conference, Bloomington, IN, June 2nd -5th

2010 Gray, P.B., and **Young, S.M.** *A Cross-Cultural Perspective on Human-Pet Dynamics* American Association of Physical Anthropologists annual meeting, Albuquerque, NM, April 14th -17th (presented by Peter B. Gray)

2009 **Young, S.M.**, and Benyshek, D.C. *Human Placentophagy: Maladaptive or Misplaced Cultural Taboo?* Human Behavior and Evolution Society Conference, Fullerton, CA, May 27th - 31st, poster presentation

2009 **Young, S.M.**, and Benyshek, D.C. *Human Placentophagy: Maladaptive or Misplaced Cultural Taboo?* Southwestern Anthropological Association Conference, Las Vegas, NV, April 30th – May 3rd.

2009 **Young, S.M.**, and Benyshek, D.C. *Placentophagy: A Universal Human Taboo* University of Nevada, Las Vegas Graduate and Professional Student Association Research Forum, Las Vegas, NV, March 28th, awarded second place prize in poster competition

2005 **Young, S.M.** *Were the Hobbits really human? A comparison of* H.floresiensis *to pygmy mammals and modern human dwarfs to determine the possibility of a dwarf species.* James C. Young Colloquium, Riverside, CA, February, and Southwestern Anthropological Association Conference, San Jose, CA, April 28th - 30th.

SERVICE

Professional

2012 Member, Graduate Student Events Committee, and Student volunteer for the Society for Cross Cultural Research, 41st Annual Meeting, Las Vegas, NV
2011 Ad hoc reviewer, *Ecology of Food and Nutrition*

University

2015-Present Member, UNLV Top Tier Student Success Subcommittee
2014- 2015 Vice Chair and UNLV GPSA Representative, Nevada Student Alliance of the Nevada System of Higher Education
2014- 2015 President, UNLV Graduate & Professional Student Association
2014- 2015 Member, UNLV Tier One Steering Committee, and Student Achievement Subcommittee
2014- 2015 Chair, UNLV Graduate & Professional Student Association Bylaws Committee
2014- 2015 Chair, UNLV Graduate & Professional Student Association Ad hoc Student Health Insurance Committee
2014- 2015 Member, UNLV President's Advisory Council
2014- 2015 *Ex officio* Member, UNLV Alumni Association Board of Directors
2014 Member, UNLV Parking Advisory Committee
2014 Student Presenter, UNLV Graduate & Professional Student Association Workshop, *Polishing Your Presentation Skills & Preparing an Excellent Poster*
2013-2015 Member, UNLV Student Health Insurance Committee
2013-2015 Presidential Student Ambassador
2013-2014 Member, Nevada Regents' Academic Advisor Award Selection Committee
2013 Member, Selection Committee for UNLV Graduate College Associate Dean for Academic Affairs
2013 Member, Selection Committee for UNLV Vice President for Research and Economic Development
2013 Member, UNLV Student Academic Misconduct Policy Review Task Force
2013 Commencement Student Marshal
2012-2014 Vice President, UNLV Graduate & Professional Student Association, May 2012-January 2014, Acting President, September – November 2012
2012-2014 Chair, UNLV Graduate & Professional Student Association Sponsorship Committee
2012-2014 Chair, UNLV Graduate & Professional Student Association Research Forum
2012-present Member, UNLV Graduate & Professional Student Association Government Relations Committee
2012-present Member, UNLV Graduate College Professional Development Committee
2012-present Member, UNLV Graduate College Faculty and Student Issues Committee

2012-2013 Member, UNLV Foundation Distinguished Teaching Award Selection Committee
2012-2013 Co-organizer, UNLV Graduate & Professional Student Association sponsored Graduate Student Research Brown Bag Series
2012 Member, Graduate & Professional Student Commencement Speaker Selection Committee
2011 College of Liberal Arts Representative, UNLV Graduate & Professional Student Association Summer Council
2010-2012 Anthropology Department Representative, UNLV Graduate & Professional Student Association Council
2010-2012 Member, UNLV Graduate & Professional Student Association Grants Committee
2010-2012 Member, UNLV Graduate & Professional Student Association research Forum Committee
2010-present Member, UNLV Student Conduct Hearing Board

Departmental

2014 Student Presenter, Lambda Alpha Honor Society Workshop, *Building Your CV*
2014 Judge for Undergraduate Student Poster Presentations, UNLV Anthropology Research Forum
2013-2014 Student Coordinator, UNLV Anthropology Department Graduate Student Peer Mentoring Program
2013 Chair, Judging Committee, UNLV Anthropology Research Forum. Judge for Graduate Student Poster Presentations
2013 Student Presenter, Lambda Alpha Honor Society Workshop, *Grants and Other Funding: What, Where, When?*
2012-2013 Laboratory Volunteer, Anthropology Department Open House, Metabolism, Anthropometry and Nutrition Laboratory
2009-2012 Secretary and Treasurer, UNLV Chapter of Lambda Alpha National Anthropology Honor Society
2009 Student Presenter, UNLV Anthropology Society Brown Bag Presentation, *Human Placentophagy*
2008-2010 Member, UNLV Hormones and Disease Group Fundraising Committee, and 2009-2010 Newsletter Editor

Community Outreach

2015 Invited Speaker, *The Mobile Lab: Doing Biomedical Anthropology in the Field*, Dawson College Bound Program Anthropology Course, Alexander Dawson School, Las Vegas, NV, July
2015 Invited Speaker, *The Past, Present, and Future of Placentophagy Research*, PlacentaCON, Las Vegas, NV, March
2014 Invited Speaker, *Doing Fieldwork in Biomedical Anthropology*, Dawson College Bound Anthropology Course, Alexander Dawson School, Las Vegas, NV, July
2012 Guest Lecture, *How Diet Changed Human History*, Trinity International School, Las Vegas, NV, September
2011 UNLV Anthropology Department representative, Career Day, Mannion Middle School , Henderson, NV, December

2011 Guest Lecture, *An Overview of Anthropology*, Trinity International School, Las Vegas, NV, September

ACADEMIC AND PROFESSIONAL MEMBERSHIP

American Association of Physical Anthropologists (AAPA)
American Anthropological Association (AAA)
Evolutionary Anthropology Society (EAS)
Biological Anthropology Society (BAS)
Lambda Alpha Honor Society, UNLV, Las Vegas, NV

MEDIA COVERAGE OF RESEARCH

Fox Channel 5 Local News
Fox News National
KNPR, State of Nevada
Las Vegas Sun
UNLV Magazine