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MASTER'S CAPSTONE PROJECT
BETHEL UNIVERSITY

BY

LAUREN E BENNETT & LISA M BROWN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF SCIENCE IN NURSE-MIDWIFERY

MAY 2018

BETHEL UNIVERSITY

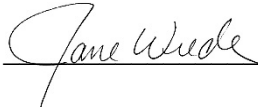
Menstrual Cycle as a Vital Sign

LAUREN E BENNETT & LISA M BROWN

May 2018

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We would like to express our sweet thanks to our family members and loved ones. You watched us spend endless hours of time dedicated to school. There were times we know you have felt ignored, abandoned, or unimportant, but you gave us so much grace. You listened to us cry out in fear, stress, and anxiety, but you never gave up on us. You provided us with love, encouragement, food, fuel, and good laughs. You pushed us to work harder, knowing we had already given every ounce we had.

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Lauren Bennett and Lisa Brown

Abstract

Purpose:

The purpose of this paper is to examine and explore which factors affect the menstrual cycle and how the menstrual cycle has a significant health impact on women's lives.

Theoretical framework:

Dorothea Orem, with the Orem Model of Nursing is patient driven. Orem's beliefs are based on promoting life processes, modes of functioning within health and disease, growth and development, and movement within space. Learning about menstrual cycles and fertility, achieving or preventing pregnancy, delivering a baby, and becoming a mother are all comprised of multiple journeys that are intertwined within one another in women's health.

Research articles:

Twenty-two research articles were studied for their purpose and significance in relationship to what affect they have on menstrual cycles and women's health.

Results & Findings:

Ovulation, menstrual cycle irregularity, infertility, birth control, stress, illness, and disease all play an important role into affecting a women's menstrual cycle.

Conclusion:

Fertility awareness is a key nursing intervention to identify health deviations, identify and implement self-care methods and actions that promote optimal health and wellbeing. Fertility awareness is an integral aspect of reproductive health that provides a visual picture into reproductive function and health.

Key Words: key words used for the search included: (a) menstrual cycle; (b) fertility; (c)

ovulation; (d) anovulation; (e) dysfunction; (f) menses; (g) menstrual cycle perceptions; (h) menstrual cycle culture; (i) menstrual cycle dysfunction; (j) luteal phase disorders; (k) abnormal uterine bleeding; (l) natural family planning; (m) normal menstrual cycle; (n) menstrual cycle homeopathy; (o) infertility; (p) amenorrhea; (q) menstrual complications; (r) uterine bleeding; (s) menses; and (t) menarche education.

Table of Contents

Acknowledgments.....3

Abstract.....5

Chapter I: Introduction.....9

 Statement of Purpose.....15

 Evidence Demonstrating Need.....17

 Significance to Nurse-Midwifery.....22

 Conceptual Model/Theoretical Framework.....23

 Summary.....28

Chapter II: Methods.....29

 Search Strategies.....29

 Criteria for Inclusion and Exclusion.....30

 Evaluation Criteria.....30

 Summary.....31

Chapter III: Literature Review and Analysis.....33

 Introduction.....33

 Wellness.....33

 Ovulation.....33

 Signs of Ovulation.....34

 Perimenopause.....38

 Technology.....38

 Dysmenorrhea.....39

 Acupuncture.....40

Stress.....41

Abnormal Menstrual Patterns..... 42

Social and Environmental Factors..... 42

Shift Work..... 43

Illness..... 45

PCOS..... 45

Abnormal Uterine Bleeding..... 47

Chapter IV: Discussion, Implications, and Conclusion.....50

Literature Synthesis..... 50

Amenorrhea..... 51

Infertility..... 54

Birth Control..... 56

Developing Country Disparities..... 57

Recommendations for Future Research..... 59

Integration for Dorthea Orem’s Nursing Theory..... 60

Conclusion..... 60

References..... 62

Matrix..... 69

Chapter I: Introduction

The menstrual cycle is an exquisite and intricate series of events that take place in a woman's body. The physiology of ovulation is a continuous process that begins during fetal development in intrauterine life. The female fetus has one to two million immature eggs present during the intrauterine period. Many of the eggs are lost during ovarian follicle atresia and about 300,000 to 400,000 are left by the time the female reaches puberty (Vigil et al., 2017). The process of ovulation becomes evident to young women during puberty when menarche begins with the activation of the feedback loop system of the hypothalamus-pituitary-ovarian axis. This creates the fertility cycle that occurs repeatedly throughout the span of a woman's childbearing years. The American College of Obstetricians and Gynecologist (ACOG) declares childbearing years to be from menarche to menopause (2017), however, ACOG also state the majority of women have children between the ages of 20-35 years. Conception after age 35 can be marked with early perimenopause symptoms which include irregular menses and menorrhagia as well as the potential for decreased fertility (ACOG, 2017). Therefore, for the purpose of this paper, we will refer to childbearing years related to menses as a vital sign to the health of women between ages 20-35 years.

During a woman's lifetime, she will cycle monthly with a cascade of events that make up her menstrual cycle and fertility. The hormones and bodily mechanisms involved in the fertility cycle are intricate, complex and often affected by the health of the woman. In the production of an adequate and healthy fertility cycle, these mechanisms function collectively to produce optimal reproductive health.

Two of the most prevalent methods of natural family planning are the Ovulation Method and the Creighton Model Method. The Ovulation Method was developed by John Billings and

his wife, Evelyn. The Billings couple were Australian physicians who based the signs of ovulation, known as the Ovulation Method, now into the Billings Ovulation Method. Their original research laid the foundation for what has become “The single most studied observation of natural fertility regulation (Hilgers, p. 183, 2004)”. They showed that ovulation can be recognized by women and used as a biomarker of health. Based on this foundational research, the Billings Ovulation method was further developed in 1966 (Billings & Westmore, 2000; Hilgers, 2004). The Creighton Model Method is a highly scientific fertility awareness method developed by Dr. Thomas Hilgers. It is based on a woman’s ability to discern the qualities of external cervical mucus observation to determine ovulation and the window of fertility.

The menstrual cycle has multiple types of cells, hormones and organs all working synergistically. The majority of women have cycles that are between 28-32 days in length however, the accepted normal range of menstrual cycles is 21-36 days (Billings & Westmore, 2000; Hilgers, 2004). Women on a monthly basis, tend to have a variation of only 3-4 days’ in their cycle length (Hilgers, 2004).

The menstrual cycle is a complex, multi-organ system which includes the hypothalamus, thyroid, pituitary and adrenal glands, uterus and ovaries that all working simultaneously, each with their own roles in the process (AAP, 2006; Blackwell et al., 2013; Billings & Westmore, 2000; Gonzalez, 2017; Hilgers, 2010; King et al., 2015; Popat, Prodanov, Calis & Nelson., 2008; Vigil et al., 2017). The uterus and ovaries are two distinct organs involved in the menstrual cycle. The uterus and ovaries progress through three phases that mark the process of the fertility cycle.

The endometrial phases depict the changes to the uterus during a normal cycle. These include the menstrual, proliferative and secretory phases. The menstrual phase is marked with

bleeding that sheds the endometrial lining. The proliferative phase follows the bleeding and ends when ovulation occurs. During the proliferative phase, the endometrial lining begins to grow under the influence of estrogen. Last is the secretory phase where the endometrial lining continues to grow and develop in preparation to support a potential pregnancy.

The three phases of the ovaries are the follicular, ovulation and luteal phases. The follicular phase begins after menstrual bleeding and defines the period of time until ovulation occurs. It is highly influenced by estrogen, luteinizing hormone (LH) and follicle stimulating hormone (FSH). This phase of the cycle has the greatest degree of variation in number of days. A surge of FSH and LH hormones stimulate the release of a mature ovum from the ovary; this is ovulation. The ovum is viable for 12-24 hours; this is the only time conception can occur (Billings & Westmore, 2000; Hilgers, 2010, Vigil et al., 2013). The follicle that released the ovum turns into the corpus luteum which produces progesterone. The several days leading up to and following ovulation is referred to as the “window of fertility.” The luteal phase immediately follows ovulation and is influenced by higher levels of progesterone. The luteal phase is considered an infertile time and is the most consistent phase of the ovarian cycle. The normal luteal phase lasts 9-14 days. If a woman is having an abnormally long or short cycle, it is most often the follicular phase of the cycle that changes in the number of days, not the luteal phase.

A normal cycle differs from one woman to another with variation in cycle length, timing of ovulation and bleeding. Normal and average are two different matters when speaking about menstruation. It is *normal* to have a cycle that lasts as few as 21 days or as long as 36 days, meaning there is not a medical concern with either end of that spectrum. The *majority* of women have cycle lengths that are 28-32 days long with the most common cycle length being approximately 27 days +/- (1) day (Billings & Westmore, 2000; Hilgers, 2010; Vigil et al.,

2013). During adolescence, in the first years of menstruation, normal cycles range from 21-45 days in length (Gonzalez, 2017).

The level of estrogen rises during the follicular phase and is at its highest peak just prior to ovulation. This rise in estrogen produces observable signs of the cervix during the time of ovulation (Hilgers, 2004). Dr. Billings (2000) and Dr. Hilgers (2004) demonstrated that there are visible and tangible changes during ovulation which represent reproductive health. These observable signs include both increased volume of cervical mucus and mucus with an extremely high water content (Hilgers, 2010).

Luteinizing hormone (LH) is a normal hormone produced in the female anterior pituitary gland and is associated with the reproductive and menstrual cycle. As estrogen and LH levels rise, mucus becomes clear, lubricative and stretchy (Billings & Westmore, 2000; Blackwell et al., 2017, Hilgers, 2010; Vigil et al., 2013). The pH of cervical mucus at this time is 7-14, much more alkaline, to allow for survival of sperm, whereas the pH of the vagina at other times during the cycle is about 4.5 (Hilgers, 2010). The cervix visibly dilates slightly during ovulation and closes again after ovulation has occurred. A retrospective sign that ovulation has occurred is a rise in basal body temperature. In healthy women, the rise is at least .3 degrees Fahrenheit above preovulatory temperatures (Hilgers, 2004). This is caused by the rise in progesterone after ovulation has occurred. After ovulation has occurred, the endometrium transitions into the secretory phase while the ovaries begin the luteal phase of their cycle (Billings & Westmore, 2000; Blackwell, 2017; Hilgers, 2004). This phase of the fertility cycle has the most stability, essentially staying the same despite the length of that cycle for women (Billings & Westmore, 2000; Hilgers, 2004). According to work of Drs. Billings and Hilgers, almost every woman has a luteal phase somewhere between 9-14 days (2000; 2004). Individually, women from cycle to

cycle have an even smaller variation of only about 3 days (Billings & Westmore, 2000; Hilgers, 2004). The secretory phase and luteal phases of the cycle end when a new menstrual phase begins with bleeding. This signifies the beginning of the process all over again.

Identifying the biomarkers of the fertility cycle is a useful tool for women and medical professionals (Billings & Westmore, 2000; Blackwell et al., 2013; Hilgers, 2010; Gonzalez, 2017; Vigil et al., 2017). These biomarkers are changes in cervical mucus, changes in vaginal sensation, basal body temperature, condition of the skin, pain, mood, and changes in the cervical os (Billings & Westmore, 2000, Blackwell et al., 2013; Fehring, Schneider & Raviele, 2006; Gonzalez, 2017; Hilgers, 2010; Vigil et al. 2017). Each phase has specific biomarkers that take place during the menstrual cycle. Confident identification of the signs of fertility and ovulation are as follows: 1. Cervical mucus increases in amount as ovulation approaches, 2. Cervical mucus changes from cloudy to clear as ovulation approaches, 3. Cervical mucus becomes stretchy as ovulation approaches, 4. Cervical mucus can stretch as far as one inch or more during the peak day of ovulation, 5. The cervical os dilates slightly during ovulation, 6. There is an increasing vaginal sensation of lubrication while wiping as ovulation approaches, 7. The peak sensation of lubrication is on the day of ovulation, 8. Basal body temperature (BBT) shifts upward by .3-.5 degrees Fahrenheit once ovulation has occurred, 9. The position of the cervix in the vaginal canal moves slightly higher during ovulation. Some of these signs are tangible external signs while others are internal only. The changes in cervical mucus throughout the cycle and BBT are the most easily identifiable signs that a woman can chart. This serves as the basis and theory behind the menstrual cycle as a vital sign of optimal health.

When a woman charts these signs, it paints a picture of the inner workings and function of the female body. Using this visual picture, we get an inside look at when and if ovulation

occurred, if bleeding is normal, or abnormal, if hormone levels are adequate, if endocrine function is normal, how lifestyle choices affect cycles and what disease processes may be developing. With the knowledge of how normal processes and disease processes present itself in the cycle, women and their health care providers are able to work towards optimal health.

The majority of women have what is considered a “normal and regular” menstrual cycle, consisting of ovulation and menstrual bleeding every 28-35 days (Billings & Westmore, 2000; Hilgers, 2004). However, not all women have that experience. In our effort to discover the effects of health on fertility, we need to discover what is normal and what is outside of normal. Often, providers focus on bleeding as the benchmark of normalcy in fertility and center their efforts on normalizing bleeding. However, Vigil et al., (2013) states that regular ovulation is an even greater indicator of optimal health. Awareness of the signs of ovulation and recording these signs provide information that could easily aid providers in early detection of ongoing health issues that a woman may experience throughout her reproductive life (Billings & Westmore, 2000; Blackwell et al., 2013; Hilgers, 2010; Popat, Prodanov, Calis, & Nelson, 2008; Vigil et al., 2017). In addition, biomarkers of fertility enable women to recognize the ovarian continuum. Vigil et al. (2017) reports that normal ovulatory activity implies adequate endocrine and gonadal function.

While normal and average are different, according to Fehring, Schrider & Raviele (2006), a normal woman’s cycle in the follicular phase ranges from 11-27 days and the luteal phase from 7-15 days. Follicular phase and luteal phase in this study were established with a basal body temperature (BBT) shift as the biomarker of ovulation. The BBT naturally shifts upward once ovulation has occurred.

As providers it is important to take the time to evaluate the menstrual cycle as a key vital sign with patients. According to Popat, Prodanov, Calis, & Nelson (2008), it is extremely common for providers to associate loss of menstrual cycle regularity to stress in a woman's life. In one study of 44 women with secondary amenorrhea, it took providers more than five years to diagnosis 25% of these women with primary ovarian insufficiency. Whether these providers related irregular menstruation to stress, or other issues, the fact that it took over five years to diagnosis 25% (n= 11) of these women is not acceptable.

Popat et al. (2008) identified common reasons why menstrual cycle irregularity may occur. These include pregnancy, medications, chronic disease, eating disorders (anorexia and bulimia), stress, hypothalamic dysfunction, Polycystic Ovarian Syndrome (PCOS), ovarian tumors, exercise-induced amenorrhea, thyroid dysfunction, and more. This paper will provide an overview of literature to identify what factors affect menstruation and what the predictors look like for women to have optimal health in regards to their own health and fertility.

Statement of Purpose/Question to Address

The purpose of this paper is to explore scholarly literature that supports the evidence of our PICO question, "How is the menstrual cycle a vital sign and predictor for optimal health in reproductive age woman?" The focus will be on a variety of disease processes such as PCOS, obesity, and abnormal uterine bleeding, as well as lifestyle factors such as exercise, smoking, night shift work, and nutrition. These factors have all been shown to affect menstrual patterns, fertility, and overall health.

The importance of fertility awareness in terms of health status (and family planning) starting in adolescence is well documented in the American College of Obstetricians and Gynecologists (ACOG), the American Academy of Pediatrics (AAP) and the American

Academy of Family Physicians (AAFP). The terms fertility awareness and Natural Family Planning (NFP) are used synonymously. NFP is fertility awareness with the added step of making an intentional decision to avoid or achieve pregnancy during times of fertility. The AAFP states that fertility awareness family planning (FAFP) is a unique option for couples with the advantage of observation of one's own body, knowledge of the biomarkers of fertility and the lack of adverse medical side effects (Smoley & Robinson, 2012). The added benefit of FAFP is that couples are able to space and time pregnancy. More couples use FAFP for achieving than avoiding pregnancy (Smoley & Robinson, 2012). AAFP states that motivation and commitment on behalf of the couple in adhering to the method is a significant determining factor in the typical use effectiveness success rate (Smoley & Robinson, 2012). However, typical use effectiveness of the particular fertility awareness method, Creighton model method of family planning is two to five unplanned pregnancies per 100 couples and perfect use of <1 unplanned pregnancy per 100 couples. This makes it an extremely reliable method of family planning (Hilgers, 2010; Smoley & Robinson, 2012).

An ACOG committee opinion (2015) asserts that the menstrual cycle does play an important part in women's health. This role will come in the form of education for women to recognize what is normal and expected during a menstrual cycle. Parents or caretakers may be unaware of what is considered to be "normal" for girls, especially dealing with the start of the menstrual cycle, or their very first period. ACOG outlined four main recommendations to guide clinicians on this path. These recommendations include:

1. Clinicians need to recognize that educating girls and their parents/guardians about what they can expect with menarche (including what is normal and what it looks like going

forward). Clinicians should not assume that parents, guardians, family members, siblings, teachers at school, or friends are educating the girl on this topic.

2. Once a girl has started her menses, clinicians should be asking at every visit (well-woman, physical exam, etc.) about the patients' menstrual cycle history, including the LMP.
3. Clinicians need to recognize that identifying abnormal menstrual cycles in the adolescent period may aid in early detection of potential health concerns for the patient.
4. Finally, it is crucial that clinicians understand the menstrual cycle patterns of adolescent girls. This includes being able to differentiate normal vs. abnormal cycles.

ACOG also has an anticipatory guidance section in their committee opinion that stresses the importance of clinicians talking to girls during their 7-8-year-old visits about menarche (ACOG, 2015). This could be significantly beneficial to encourage or allow young girls to ask questions and be more in tune with their bodies and the changes that will occur soon.

Evidence Demonstrating Need

A woman's knowledge of potential health conditions and the ability to recognize optimal health is needed for the adequate promotion of self-care behaviors. In the absence of optimal health, and/or in the event of pathological illness or the presence of disease processes, self-care can be prompted by fertility awareness.

Amenorrhea can be a sign of pregnancy, pathological illness, or disease. Amenorrhea is defined as three months without a menstrual cycle. Women who experience amenorrhea can have underlying pathologies. Dysfunction of the hypothalamic-pituitary-adrenal axis is the number one cause of amenorrhea. Other causes of amenorrhea are hyperprolactinemia, tumors, genetics and certain medications (Fourmen & Fazeli, 2015). When women are aware of their

fertility, they will also notice the presence or absence of mucus. Women who are experiencing amenorrhea will often have an abnormally, predominantly dry mucus pattern which is indicative of absent or decreased ovulation (Hilgers, 2010).

Irregular menses is another sign of potential illness or pathology. Goodman et al (2017) lists Polycystic Ovary Syndrome [PCOS] as the number one reason for cycle irregularity and dysfunction. PCOS can be easily identified by tracking the menstrual cycle and patterns. Using menstrual patterns as a standard question for childbearing women can screen for and even identify many pathologies that may otherwise go undiagnosed. These disorders can cause additional comorbidities such as insulin resistance, abnormal uterine bleeding, depression, infertility, and more if not treated promptly and properly. For this reason, it is important that menstrual patterns be discussed at every well-woman visit.

The Center for Disease Control and Prevention (CDC, 2016) estimates that approximately 12.1% of women (ages 15-44) have impaired fertility, and 6.7% of married women (ages 15-44 years) are infertile. ACOG (2017) defines infertility as the inability to become pregnant after one year of having regular sexual intercourse with no use of birth control. When it comes to men and women, there are many factors that can cause fertility problems. In over 50% of women with infertility *and* regular cycles, ovulation is either absent or defective (Hilgers, 2010). The most common endocrine disease in women is PCOS, which causes anovulation, irregular ovulation and irregular cycle patterns (Goodman et al., 2015). Ovulation dysfunction is the most common cause of female infertility, while in men, varicocele of the testes, causing sperm dysfunction, is the most common cause of male infertility (Punab et al., 2017). Other common causes of infertility include thyroid disorders, hormone imbalances, sexually transmitted infections, endometriosis, and many other health conditions (ACOG, 2017). Other factors also affect

fertility. Common factors would include age (chances of getting pregnant moderately decline after age 30, and greatly after age 37), lifestyle habits such as diet, exercise, smoking, alcohol intake, (and more) (ACOG, 2017). For a healthy couple in their 20s or 30s, the chance of getting pregnant is 25-30% in any single menstrual cycle (ACOG, 2017). It is encouraging to note that up to 25% of the time there is definite potential for conception to occur. However, after age 40, a woman's chance of conceiving in any cycle drops to less than 10%, which is a significant decrease in achieving pregnancy (ACOG, 2017).

Infertility can lead couples to consider in-vitro fertilization (IVF). IVF is a form of assisted reproductive technology (ART) that involves the process of fertilization by extracting eggs, retrieving a sperm sample, and then manually combining an egg and sperm in a laboratory dish. The American Pregnancy Association (APA) tracks IVF data: IVF is expensive, costing up to \$35,000 per round (American Pregnancy Association, 2017). Live birth rates for IVF cycles include the following: for women 34 years old and under, 41-43%; women 35-37, 33-36%; women 38-40, 23-27%. Women age 40 and over, 13-18% need IVF to conceive (American Pregnancy Association, 2017). Besides the cost, it is not uncommon to have a multiple gestation pregnancy, increased chance of an ectopic pregnancy (a fertilized egg that implants outside the uterus), infection, premature delivery of baby, and others (American Pregnancy Association, 2017).

In addition to health awareness and identification of underlying pathology, fertility awareness and menstrual cycle knowledge can help women delay, postpone, or avoid pregnancy. The CDC (2016) states that 15.9% of women (ages 15-44) are currently using the pill, while 8% of women (ages 15-44) are using long-acting reversible contraception devices such as an implant or device (like Mirena, Paragard, Kyleena, Nexplanon, etc.), 14.3% of women (ages 15-44) are

using female sterilization, and 4.5% of women (ages 15-44) are using male sterilization as their form of birth control. Another birth control method is condom use, which is approximately 14.3% (NFPTA, 2017). Worldwide, 2.9% of women use Natural Family Planning (NFP). This is approximately 32 million couples worldwide. NFP has a long history. In 1971, Mother Teresa educated 20,000 very poor couples in Calcutta, India on NFP. The resulting pregnancy rate for these couples was 0.2%. Furthermore, in 2004, the China Project reported that there were 48,000 NFP teachers used in China, which resulted in 3,600,000 couples using this method (NFPTA, 2017). The pregnancy rate was 0.61%. Overall, this method shows to be extremely successful at postponing pregnancy all over the world, and can be taught to women, or couples from all walks of life (NFPTA, 2017).

The importance of fertility awareness in terms of health status (and family planning) starting in adolescence is well documented in the American College of Obstetricians and Gynecologists (ACOG), the American Academy of Pediatrics (AAP) and the American Academy of Family Physicians (AAFP). The terms fertility awareness and Natural Family Planning (NFP) are used synonymously. NFP is fertility awareness with the added step of making an intentional decision to avoid or achieve pregnancy during times of fertility. The AAFP states that fertility awareness family planning (FAFP) is a unique option for couples with the advantage of observation of one's own body, knowledge of the biomarkers of fertility and the lack of adverse medical side effects (Smoley & Robinson, 2012). The added benefit of FAFP is that couples are able to space and time pregnancy with more couples using FAFP for achieving than avoiding pregnancy (Smoley & Robinson, 2012). AAFP states that motivation and commitment on behalf of the couple in adhering to the method is a significant determining factor

in the typical use effectiveness success rate (Smoley & Robinson, 2012). As stated before, efficacy is very high for the Creighton Model Method, with a typical use effectiveness of 97%.

About 25% of women in the US use hormonal contraception or birth control. It requires consistent use and does have a failure rate (Reproductive Health, 2017). It is also important to also consider that hormonal birth control has side effects such as nausea, vomiting, headache, vertigo, breast tenderness, irregular bleeding or spotting, blood clots, and death. Some ethical considerations to take into account is that birth control prevents pregnancy by thinning the endometrial lining in the uterus, which decreases the chance to hold or sustain a pregnancy, as well as inhibits ovulation (King et al., 2015). These ethical considerations affect each woman differently, as she is entitled to her own beliefs about what she thinks is right for her body. It is imperative to educate women on these topics, so they feel supported and empowered with their health decisions.

Pregnancy is a significant health risk for some women. Although maternal mortality rates continue to decline, countries like Haiti and Uganda still have maternal mortality rates of nearly 400 per 100,000 live births (World Health Organization, 2016). It is essential that these women avoid pregnancy. The World Health Organization (WHO) recognizes the need for and the health benefits of fertility awareness and family planning for women of all ages around the world. The cost and availability of barrier, hormonal or implantable birth control options for many makes using these methods unrealistic for women around the world and puts them at risk for an unplanned pregnancy. NFP is a low-cost, effective option for all women. In fact, the sympto-thermal method of NFP can have a typical use effectiveness rate of up to 98% for avoiding pregnancy (WHO.org, 2018). Both the WHO and FP2020 acknowledge the global health benefits of child spacing and the lack of contraceptive availability to many poor

nations. Although NFP does not protect against STIs and does not address the issues of cultural practices, gender based barriers, user bias, fertility awareness is a valuable tool for recognizing the biomarkers of fertility and reproductive health.

Significance to Nurse-Midwifery

Nurse-midwives are advanced practice nurses (APNs). Nurse-midwifery is recognized in all US states. As of August 2017, there are 11,826 certified nurse-midwives (CNM) in the United States (ACNM, 2017). CNMs are independent healthcare providers who practice and attend births in the hospital setting the majority of the time (92.4%, ACNM, 2016), but can also attend births at out-of-hospital birth centers and in the home. In addition to practice, nurse-midwives have prescriptive rights and abilities. The American College of Nurse-Midwifery has outlined characteristics of what they believe to be the art and science of midwifery (King et al., 2015). The first hallmark of midwifery recognizes that ovulation and menarche are normal physiological and developmental processes that women will experience throughout their lifetime. Nurse-midwifery celebrates that during intrauterine life, females develop nearly seven million primordial follicles in the ovaries and during her childbearing years, she will ovulate about 500 oocytes (Vigil et al., 2017). This is important because all women, starting at a young age, need to realize that menarche is an exquisite, normal and healthy process. Another hallmark of midwifery is health promotion and education. In relation to the PICO question, education on the fertility cycle will encourage women to ask their providers questions about their own health and give providers opportunities to educate women on health promotion. The final hallmark of midwifery includes empowering women as a partner in their health care. One of the most important hallmarks in relation to nurse-midwife is coming alongside of women and empowering

them to learn their strength and educate themselves on their bodies, particularly their reproductive cycle.

The beauty and majesty of the female body, created in the image of God, is celebrated by midwives all over the world. *“I praise You because I am fearfully and wonderfully made; Your works are wonderful; I know that full well”* Psalm 139:14. The intricacies of the female body are astounding. The abilities to menstruate, procreate, gestate and lactate are nothing short of miraculous. It is in these processes that midwives base their entire career, for health promotion, disease prevention and health education (King et al., 2015). Midwives are perfectly positioned to use evidence-based research to skillfully guide and counsel women on their choices throughout their reproductive lives.

Conceptual Model/Theoretical Framework

Dorothea E. Orem was born in Baltimore, Maryland in 1914. After she earned her nursing diploma, she was driven to continue her education. She was persistent and went on to complete her Bachelor of Science in Nursing, followed by her Master of Science in Nursing in 1945 from Catholic University of America in Washington, D. C. Orem earned many honors and awards in her nursing career through various universities across America. She wrote many scholarly articles and in 1959, Orem defined the “Self-care deficit nursing theory”. She continued to develop her theory through many observations and studies and a selected collection of her scholarly work can be found in *Self-Care Theory in Nursing, selected papers of Dorothea Orem* which is referenced in this literature review (Orem, Renpenning & Taylor, 2003).

Dorothea Orem defined self-care as an action made to one’s self or environmental inputs. These actions and inputs could be self-directed, self-permitted, deliberate or ego-processed. The term “self-care” was first used in 1956 as activities that contributed to health or recovery that an

individual would perform if he or she had the necessary strength, will or knowledge. Self-care needs are both subjectively and objectively definable and universal to all humans. It is an essential input to an individual's environment in order to maintain or optimize human function. Self-care deficits arise in relation to health deviations and require a wide range of skills. Actions that contribute to the continuance of life, health and wellbeing are part of self-care (Orem, Renpenning & Taylor, 2003).

Orem found that the basic level of a self-care theory made it necessary to differentiate self-care deficits due to age and development from self-care deficits that necessitate nursing intervention. The nurse has a responsibility to fulfill a role in identifying self-care needs. A nurse is not able to fulfill the role responsibilities if they ignore this area of human endeavor. Doing so would contribute to the failure of the structuring and validation of knowledge about self-care and dependent care (Orem, Renpenning & Taylor, 2003). Thus came dependent-care deficit as a completely different situation and scenario from self-care deficit. Dependent-care deficits are those deficits that stem from developmental and age limitations and not in the form of a need for intervention.

One of the basic understandings of this theory was to differentiate existing limitations, developmental age and dependent-care deficits from a health situation, deficit for engaging in self-care or deficit that required nursing intervention (Orem, Renpenning & Taylor, 2003). Orem stated that self-care is not necessarily performance of the acts, but seeing the relationship among factors like diet, activity, day to day adjustment and care actions. This is the foundational application of this theory in relation to knowledge of the fertility cycle as a measurement of optimal health and an extension of self-care actions.

The working framework for the self-care theory is 1. Identify the self-care requisites, 2. Identify self-care measures, methods and actions, 3. Identify self-care behaviors of individuals in reality situations, 4. Identify self-care systems of individuals in reality. When applying the theory of self-care and self-care requisites, basic knowledge related to one's own reproductive health is essential in the acquisition of optimal health and wellbeing. This theory is grounded in the nurse-midwifery model of care. By using the intervention of fertility awareness methods and actions, applied to individual behaviors and systems, women are able to meet their own reproductive care needs.

Orem developed three specific self-care concepts. Self-care requisites, therapeutic self-care demand and self-care operations (Orem, Renpenning & Taylor, 2003). Self-care is self-initiated and self-directed actions of a person to know their current state of health and the future requirements for regulation of their own function and development. Self-care is an integral part of regulating human function and human development. People care for themselves in many ways and by doing so, they are able to live in as optimal state of health as possible given their current condition. The Orem Model is particularly well suited for nurse-midwifery, maternal and women's health. Autonomy of health enables women to become aware of their own bodies and take responsibility for their health. By using the methods, means, and actions with which to meet the needed requirements of optimal health, they are able to sustain life and promote health and wellbeing.

Orem's beliefs are based on promoting life processes, modes of function within health, disease, growth, development and movement within space. Technology can be a useful tool in promoting self-care and can be implemented with Orem's theory. Technology is utilized as a complement to interpersonal and social processes that facilitates the roles of both nursing and

client (Nursing-theory, 2016). Another goal that could benefit from technology is that nursing should be effective and efficient in helping to compensate for deficits in self-care. In doing so, patients are working towards as much independence as possible (Nursing-theory, 2016).

Meeting universal and developmental self-care requisites is an integral part of primary care for prevention, identification and treatment of disease processes.

Orem felt that people are distinct in their own way and that nursing was a form of action and interaction between two or more people. In every situation there are two roles, that of the client and that of the nurse. The nurse must be clear about her role and take care to broaden narrow conceptualizations. By replacing narrow conceptualizations with a more comprehensive realist role, the action capacities and action demands can be helped through nursing intervention (Orem, Renpenning & Taylor, 2003). By incorporating the woman's perception, and the provider's perception of health, in addition to the requirements of care needed, health goals can be established in the context of lifestyle, health status and capacity to perform self-care.

Nursing intervention is necessary when health deviations and deficits in self-care occur. It is also necessary in the promotion of optimal health by closing the gap of knowledge and methods of action. One of the health deviations of self-care is awareness of optimal health, disease processes, pathological conditions, and its effects on general health and well-being. Teaching fertility awareness to women enhances the knowledge of women and differentiates the roles providing clarity for the intent of the intervention.

The Orem Model falls into three categories. First, self-care is universal. This includes the needs that all people require, such as air, food, water, rest, activity, and safety. Second, developmental, this relates to maturational or situational needs of a person. Last is in relation to a health deviation for a person. This means that based on a patient's condition and state of health,

if they are not able to meet their self-care needs, a self-deficit occurs. This is where the nurse, as practitioner, presents the client with the vision and support system to come alongside her and intervene with methods and actions to achieve optimal wellness. Nurses support patients, collaborate with other professionals and work towards addressing the needs each patient has.

Orem's theory stems from the understanding that all patients have an innate desire to care for themselves, and in doing so, will achieve optimal health more quickly and holistically. When women are enabled to care for themselves to the best of their ability, they grow towards a higher level of maturation and development. Orem believed that people should be responsible for their own care and the care of the people in their family. The ultimate goal is for patients to develop and attain independence in self-care (Nursing-theory, 2016).

In every situation there are two roles, that of the client and that of the nurse. These roles differentiate and allows for freedom of movement within each role. The nurse must provide clarity about her role which could be that of scholar, researcher, theorist, practitioner or a unifying combination of any of these. The nurse works to formulate and structure a combination of theoretical and practical medicine that benefits each client. The client learns about the menstrual cycle, fertility, achieving or avoiding pregnancy, birth, and becoming a mother. All of these are comprised in multiple journeys that intertwine with one another. Each aspect builds upon the other while deeper understanding and maturation occurs. Orem's theory provides insight into the importance of identifying self-care requisites, use of methods and actions to achieve optimal self-care for the purpose of health, wellness and health promotion. The commonalities between the menstrual cycle, reproductive wellness, recognition for intervention, and the role of the client as well as that of the nurse, are seen throughout the self-care deficit theory.

Summary

While using the pearls of midwifery as the backbone for optimal care for women, midwives are well positioned to establish the value and importance of fertility awareness as a vital sign of health. The hope is that this allows readers to gain a better understanding of what it looks like to come alongside women by promoting and educating optimal health care and outcomes with the normal, physiological menstrual cycle. By using the framework established by Dorothea Orem, we are able to identify health deviations in self-care and provide theoretical and practical interventions that assist women apply interventions to meet the goal of reproductive independence. With fertility awareness, the nurse will assist women to identify self-care requisites, recognize their current state of health, and establish methods and actions towards future health and wellbeing. The nurse's role is also to broaden narrow conceptualizations the patient may hold, help her work towards optimal health with her own individual behaviors, and enable her to care for herself to the best of her ability.

Chapter II: Methods

The purpose of this chapter is to review the methods used for this literature review. The scholarly literature includes research studies that depict the value of information gained from the intricate details of the menstrual cycle for reproduction, reproductive dysfunction and the health and well-being of women.

It was also necessary to search for studies discussing reproductive health and normalcy in the menstrual cycle as a sign of optimal health. Analysis of research based on the normal function of the menstrual cycle helped to define the range of normal and to identify what is outside of normal.

Search Strategies

English language, peer-reviewed articles, from the last ten years, were searched using numerous databases. Because much of the original research done on the female ovulatory mechanism, dysfunction of the reproductive system as evidenced by the abnormalities of the menstrual cycle, and signs of optimal health as evidenced by the fertility cycle was done more than ten years ago, the search was expanded. Some articles in this literature search reach back to 1978 when original studies and research were completed. These older articles are still extremely valuable in describing the reproductive mechanism in the female body which has not changed over time even as our knowledge has expanded

The key words used for the search included: (a) menstrual cycle; (b) fertility; (c) ovulation; (d) anovulation; (e) dysfunction; (f) menses; (g) menstrual cycle perceptions; (h) menstrual cycle culture; (i) menstrual cycle dysfunction; (j) luteal phase disorders; (k) abnormal uterine bleeding; (l) natural family planning; (m) normal menstrual cycle; (n) menstrual cycle homeopathy; (o) infertility; (p) amenorrhea; (q) menstrual complications; (r) uterine bleeding; (s)

menses; and (t) menarche education. Databases utilized were BioMedCentral, CINAHL, Ovid, Google Scholar, PubMed and Scopus.

Our initial search in CINAHL using the term menstrual cycles yielded 819 articles, AND ovulation yielded 94 articles AND dysfunction four articles. A CINAHL search using reproductive dysfunction yielded 104 articles AND ovulation 397 NOT in-vitro yielded 303 articles. A PubMed search using the term menstrual cycle yielded 401 articles. A CINAHL search using menarche education yielded 162 articles, menstrual complications 588 articles, and amenorrhea 823 articles. Duplicate articles were removed as the goal was to find articles that depicted the following: 1. normal fertility, 2. normal menses, 3. abnormal fertility and menses, 4. abnormal menstrual cycle occurrences, 5. evidence of health as is related to the menstrual cycle, 6. evidence of change in the menstrual cycle in relation to disease processes or a return to health and 7. natural family planning. The finalization and landing on these articles came from the topics they discussed, the data they measured, how recent the research was conducted, and how it related to the overall topic that is being researched.

Criteria for Inclusion and Exclusion

Our inclusion criteria included: 1. research studies; 2. women of childbearing age; 3. adolescents just prior to menarche or within the first year of menarche; 4. multiparous and nulliparous women; 5. women suffering from infertility, dysmenorrhea, oligomenorrhea, menorrhagia and metrorrhagia; 6. women with regular and irregular cycles; 7. women with and without evidence of ovulation; and 8. women of all ethnicities, social and economic backgrounds. Exclusion criteria were: 1. non-research studies; 2. literature reviews; 3. studies on non-humans; 4. studies on assisted reproductive technology; 5. studies on hormonal contraception; 6. girls younger than 12 and women older than 44; 7. women in menopause; 8.

cycles that were not clearly documented; and 9. cycles that did not show a relationship between general health and well-being and the menstrual cycle.

Summary of Selected Studies

The articles appraised in our search included randomized controlled trials, prospective cohorts, qualitative experimental research, quantitative research study, cross sectional study and committee opinion. The search yielded research from across the world, including articles from the United States, Canada, Brazil, Europe, Iran, United Kingdom and Australia. All of these countries are developed countries. Cultural aspects such as diet, exercise and tradition does play a role in menses reporting and development. Therefore, it was necessary to use only articles that included countries with similar privileges. Our literature review discovered a wide variety of signs and predictors for female fertility and wellness based on the signs and symptoms of the menstrual cycle. The effects of optimal health and disease processes evident in the menstrual cycle have limitless medical applications for women.

Evaluation Criteria

Each article was evaluated using the Johns Hopkins Nursing Evidence-Based Practice and levels of evidence (Dearholt & Dang, 2012). This model differentiates the levels of quality within the articles, its strengths and weaknesses. Level I studies are experimental, randomized control trials (RCT) and systematic review of RCTs; Level II is quasi-experimental, systematic review of a combination of RCTs with or without meta-analysis; Level III quasi-experimental, systematic review of a combination of RCTs and quasi-experimental studies with or without meta-analysis; Level IV is opinion of respected authorities and/or nationally recognized expert committees/consensus panels based on scientific evidence; Level V is based on experimental and non-research evidence including literature reviews, quality improvement, case reports and

opinions of nationally recognized experts based on experiential evidence (Dearholt & Dang, 2012). Our critical appraisal of literature included 22 total articles; nine Level I, six Level II, three Level III, three Level IV, and one Level VI.

Populations

Populations included adolescents and women throughout their reproductive years and at various stages of life and of various ethnicities. Ages and ranges included girls who had just started menarche, average age about 12 years old, all the way through the reproductive years to women who were perimenopausal and at the very end of menstruating, average age about 50-55 years old. This spans forty or more years of fertility for the average women. The review included women who had recently given birth, a return to fertility after childbirth, and breastfeeding women. Women who initiated specific therapy (yoga, essential oils, medications) alongside of their menstrual cycle were also included.

Summary

Overall, the Literature Review included 22 articles in its total. These articles included eight randomized controlled trials, one quasi-experimental study, four cross-sectional studies, four prospective/descriptive cohort studies, one quantitative research study, one observational cohort case control study, one descriptive study, one author manuscript, and one committee opinion. Using the research tools guided by Dearholt & Dang (2012), articles were appraised to their appropriate level and quality of evidence. The quality levels of the articles range from I to VI, providing an array of information that demonstrate quality research on this topic.

Chapter III: Literature Review and Analysis

Introduction

There are three main focuses within this literature review. They include wellness, stress, and illness. Wellness topics include: ovulation (signs, anovulation and dysfunctions), cycle length, fertility apps, complementary and alternative medicine (CAM), self-perceptions. Stress topics include: Body Mass Index (BMI), exercise, and shift work. Illness topics includes: polycystic ovarian syndrome (PCOS), diabetes, hypothyroidism and abnormal uterine bleeding.

Wellness

“For you created my inmost being; you knit me together in my mother's womb. I praise you because I am fearfully and wonderfully made; your works are wonderful, I know that full well”. Psalm 139:13-14. Wellness is an overarching theme that will be used to describe indicators used to show overall health and describes optimal goals for health in childbearing women. The work of God is beautiful and wonderful and fearfully made and the female body is a living breathing example of the miracle of life here on earth. We were knit in our mother's womb and were known to the Lord before we were even born. Nurse-midwives recognize that women have been given the privilege of bringing forth life: to grow and nourish a child with her own body.

Ovulation. Ovulation is highly dependent on a variety of factors and variables including age, ethnicity, lifestyle choices, smoking, obesity, medications, disease, exercise and stress. Reinaldo et al. (2016) studied 199 women who stated they had regular cycles and found only 113 (58%) of them had an ovulation that was proven with ultrasound. There were 86 (42%) women with regular cycles who did not ovulate. In this same study, 29 women self-reported having irregular cycles, of those 29 women, 24 (83%) of them did not ovulate, putting women with

irregular cycles six times more likely not to ovulate ($p < 0.0001$, with $p < 0.05$ considered statistically significant) (Reinaldo et al., 2016).

Signs of Ovulation. Methods of detecting and tracking ovulation have evolved over the years but the signs of fertility and remain the same. According to four studies in this review, the most fertile-type of mucus (otherwise called E type mucus) is a copious amount of mucus that is clear, lubricative and stretchy (Billings 1978; Blackwell et al., 2013; Hilgers, 2010; Vigil et al., 2017). This type of mucus is present only during the window of fertility, or the during time of ovulation and is the result of the peak production of estrogen during the cycle (Billings, 1978; Blackwell et al., 2017, Hilgers, 2010; Vigil et al., 2013). Normally the pH of the vagina is 4.5 which creates a very hostile environment for sperm, but E type mucus has a pH of 7-9 (Billings, 1978; Blackwell et al., 2017; Hilgers, 2010, Vigil et al., 2013). G type mucus, or mucus present during high levels of progesterone production, has a dense, criss-crossed pattern that block and trap sperm as well as an acidic pH which kills sperm in a matter of just a few hours (Hilgers, 2010). The lifespan of sperm in the presence of E type mucus is 3-5 days. The peak time for achieving pregnancy is six to two days prior to ovulation and declines to almost zero two to three days after ovulation has occurred (Billings, 1978; Hilgers, 2010; Sohda, Suzuki & Igari, 2017).

Six articles in the review list physiological changes that occur during the follicular and luteal phases; these are 1. cervical mucus, 2. basal body temperature, 3. position of the cervix in the vaginal canal, 4. consistency of the cervix, 5. opening of the cervical canal, 6. vaginal sensation, 7. pain, 8. skin, 9. fluid retention, 10. tenderness, 11. mood (Billings, 1978; Blackwell et al., 2013; Hilgers, 2010; Liu, Gold, Lasley & Johnson, 2004; Sohda, Suzuki & Igari, 2017; Vigil et al., 2017).

Multiple authors (Blackwell et al., 2016; Billings, 1978; Fehring, Schneider, Raviele, 2006; Sohda, Hilgers, 2010; Suzuki, Igari, 2017; van Hoof et al., 2004; Vigil et al., 2017) state that the absence or presence of cervical mucus is the main biological marker indicating ovulation. As the maturing follicles increase the production of estradiol, the rising estrogen level stimulate proliferation of the endometrium. High level of estrogen also cause for changes in the size of the cervix, increases the amount of cervical mucus, changes the physio-chemical properties of cervical mucus, and causes an upward shift in the BBT (Billings, 1978; Blackwell et al., 2013; Hilgers, 2010; Vigil et al., 2017). Mucus produced during high level of estrogen has a water content of 98-99% (Hilgers, 2010; Vigil et al., 2017).

Fehring, Schneider and Raviele (2006) discussed a study of 3,743 Danish women aged 15-44 years old where 29% of them had a cycle variation of greater than 14 days. In the same article, 786 cycles were studied and there was a variation of cycle length of 7 days in 46% of women and 20% had a variation of 14 or more days. The mean length of the menstrual cycle for women under 35 years as reported by Fehring, Schneider and Raviele was 28.9 days (SD=3.3) with a median of 29 days, mode 28 days and 95% of the cycles falling between 22-36 days (confidence interval of 95% = 21.8-36.2 days). They also found that after age 35, cycle length was an average of just over 1 day shorter at 28.2 vs 27.2 with 0.2% being shorter than 21 days and 3.6% with a cycle length of longer than 35 days (2006). Cycle length with a variation greater than 14 days was only seen in 2.2% of women with the average variation of 7 days seen by 42.5% of women.

Four studies and the American Academy of Pediatrics (AAP) highlighted that the hypothalamic-pituitary-ovarian axis can take several years to reach full maturity. As stated in the article *The Menstrual Cycle A Biological Marker of General Health in Adolescents* (Popat,

Prodanov, Calis & Nelson, 2008) as well as by the AAP (2006), the early years of menstruation commonly have anovulatory cycles and variation in cycle length is considered normal. However, only 5% or less experience cycles greater than 90 days. Girls who consistently have cycles this long should not be considered to have a normal variation of adolescence. They warrant further evaluation. Interestingly, cycles for girls who have a late onset of menarche, after age 15, can experience anovulatory cycles and not be fully ovulatory or reach full maturity until 8-12 years after the onset of menses (AAP, 2006; Popat, Prodanov, Calis & Nelson, 2008). However, up to 50% of cycles are anovulatory cycles when menarche started before 12 years of age (2006). Great variation in cycle length during this time can be physiologically normal (AAP, 2006; Blackwell et al., 2017; Fehring, Schneider and Raviele, 2006; Popat, Prodanov, Calis & Nelson, 2008; Vigil et al., 2013). The AAP states that out of 3073 girls in their first gynecological year, the median cycle length was 34 days (2006). Nearly 40% of these girls had a cycle length that exceeded 40 days but only 10% of the girls had a cycle length greater than 60 days (AAP, 2006).

Oligomenorrhea is variously defined as long or infrequent cycles, cycles that are consistently over 35 days in length or fewer than 6-8 periods in a year. In a study done by Gibbs et al., (2011) amenorrhea was categorized as no menses in the previous three months, oligomenorrhea was irregular cycles of 36–90 days, and normal or regular cycles were women with cycles of 26–35 days. This study measured exercise and its effects on women age 22.9 ± 4.3 year with a BMI of 21.2 ± 2.2 kg/m². The women were retrospectively grouped as high drive for thinness (DT) ($n = 27$) or normal DT ($n = 90$).

Psychometric, energetic, and reproductive characteristics were measured and compared (Gibbs et al., 2011). Severe menstrual disturbances, amenorrhea, and oligomenorrhea were more

often present in the high-DT group ($\chi^2 = 9.3, p = .003$) than in the normal DT group. It was found that 74% of women with a high DT were categorized as having a severe menstrual disturbance categorized as amenorrhea or oligomenorrhea while only 39% of the normal DT group had amenorrhea or oligomenorrhea ($n=79$).

Having oligomenorrhea for one to two years after the onset of menarche is indicative that oligomenorrhea will remain five and eight years later (Hoof et al., 2004). Adolescents who experience oligomenorrhea, subsequently continue to be oligomenorrheic in follow up studies 5 years later (Hoof et al., 2004). Adolescent girls with oligomenorrhea who also meet the criteria for PCOS may already have a clear clinical picture at an early age. It is also a significant predictor of oligomenorrhea at age 18 with a likelihood ratio = 45.6, $df = 2, P < 0.0001$ (VanHoof et al., 2004). Adolescent girls with irregular menstrual cycle (IMC) lengths of 35-41 days were diagnosed with oligomenorrhea 34% of the time. This is significantly greater than the 4% of girls who had IMC with cycle lengths of 22-34 days ($P < 0.001$). In girls that are 14-16 years old and experiencing oligomenorrhea, 50% will continue to have oligomenorrhea at age 18. Thus, only 35% of girls with oligomenorrhea will convert to normal menstrual cycles 2 years after menarche (Hoof et al., 2004).

Liu, Gold, Lasley & Johnson (2004) state that once a woman reaches 35 years old, there is a decrease in cycle length with an adjusted mean cycle length of -0.94 days. They report also with a confidence interval of 95% (-1.83, -0.05) that smoking, physical activity, ethnicity, and alcohol consumption impacted the mean follicular phase length. For each one-day increase in the length of the prior luteal phase length, there was an associated increase of 0.18 days in the subsequent luteal phase length (Liu, Gold, Lasley & Johnson 2004). Mean cycle lengths and phase lengths are greatly affected by prior luteal phase lengths. The luteal phase length is

affected by modifiable risk factors which include smoking, alcohol consumption and physical activity.

Perimenopause. Approximately four years prior to the end of the menstrual time in a woman's life, ovarian function and capacity is greatly diminished. This marks the perimenopausal years (Blackwell et al., 2017). It is well understood, says Blackwell et al. (2017), that during this period of time, the number of oocytes are declining.

Technology. The use of fertility tracking apps has become very popular and has aided in knowledge acquisition and self-reflection for women about their bodies. These apps attempt to predict the next ovulation based on an advanced version of the calendar method which integrates personal information into an informatics system. According to Fehring, Schneider and Raviele (2006) only 30% of women have ovulation (window of fertility) in cycle days 10-17. The calendar method is *not* a good predictor of most women's cycles (Blackwell et al., Billings, 1978; Hilgers, 2010; Vigil et al., 2017). Fertility apps are not capable of accounting for normal variation in cycles from woman to woman and from cycle to cycle in an individual woman. The massive numbers and data collected from the apps help to statistically support fertility tracking and improve accuracy (Sohda, Suzuki & Igari, 2017).

Luna is a women's health service and fertility tracking app most widely used in Japan. There were 150,000 women screened from a total of 8,000,000,000 mobile phone app users. Criteria were met when a woman had at least one complete cycle recorded with a confirmed ovulation date. Confirmation was based on ovulation with an identifier of either clinical diagnosis (ultrasound) or ovulation test kit. Sohda, Suzuki & Igari (2017) compiled data from 7,043 women with a confidence interval of 95% and found that the Pearson correlation coefficient between the length of the menstrual cycle and the length of the follicular phase or the

luteal phase was .75 ($P < .001$) and .37 ($P < .001$) respectively. This shows a positive correlation between the menstrual cycle length with the follicular and luteal phase lengths. There was a strong positive correlation between the mean length of past cycles and the mean length of follicular phase as well as statistical significance showing a relationship between mean length and follicular phase length (Sohda, Suzuki & Igari, 2017). There was also a relationship between menstrual cycle length and luteal phase length. However, follicular phase length is mostly estimated from each woman's menstrual cycle length.

Dysmenorrhea. The etiology of primary dysmenorrhea is not entirely understood yet, but Dehkordi, Baharanchi & Bekhradi (2014) state it does positively correlate with the onset of menarche in adolescents. Additionally, severity correlates with the duration and severity of menstrual flow. A randomized control study of 96 women suffering from dysmenorrhea were studied to determine the therapeutic effects of lavender inhalation on relief of dysmenorrhea, mood, hot flashes, fainting and nasal congestion ($p < 0.001$). The Andersch and Milsom's verbal multidimensional scoring system was utilized to attenuate timing and onset of symptoms. The 113 women were allocated into $n=48$ lavender and $n=48$ placebo. The estimated odds for the lavender group were 6.8 times below the placebo group in abdominal pain and backache. Estimated odds of fatigue, nausea and headache in the placebo group were 12 times above the odds for the lavender group and faintness was 16 times above the odds for lavender group. Dehkordi, Baharanchi & Bekhradi (2014) demonstrated that ordinal regression was satisfied by most of the proportional odds with $p > 0.05$ although some had a negligible unsatisfactory assumption. Lavender inhalation was shown to have an alleviating effect of the severity of dysmenorrhea along with reducing other adverse symptoms of menstruation at a statistically significant rate (Dehkordi, Baharanchi & Bekhradi, 2014).

Acupuncture. The use of the ancient Chinese treatment of acupuncture is still new to many US women. Typically, acupuncture is used to treat pain and discomfort but it also has been shown to benefit fertility as well. Cochrane, Smith, Possamai-Inesedy & Bensoussan (2016) studied women's' efforts to achieve pregnancy and the use of acupuncture. When trying to achieve pregnancy, a major factor was that of fertility awareness. When acupuncture was used, fertility awareness increased significantly by 86.4% (n=19) as opposed to (n=8) of the lifestyle modification only group. Pregnancy was achieved within 5.5 weeks with acupuncture and 10.67 weeks with lifestyle only ($p = 0.422$). The Relative Risk (RR) was 2.38, a 95% confidence interval of 1.25, 4.50 with an adjusted p value of 0.011. Although seven women became pregnant throughout the course of the study, due to the small sample size, the adjusted $p = 0.992$ indicated that acupuncture vs. lifestyle modification did not make a significant difference.

Attitudes towards menarche begin in the pre-pubescent period. The onset of puberty is a predictable sequence of hormonal changes that marks the transition from childhood into womanhood. Education on the expected changes and transitions should begin as early as seven or eight years of age as shame and embarrassment are the most cited feelings surrounding the onset of menstruation (Afsari et al., 2015). A randomized controlled trial was conducted on 364 girls and their mothers from 12 different schools (Afsari et al., 2015). The study done by Afsari et al. aimed at determining the effects of education on girls only or mothers only and the direct effect it had on attitudes towards puberty health (2015). Each girl was given a questionnaire to determine the attitudes they held towards menarche and menses. Education intervention was done for mothers only or girls only and the questionnaire was filled out again two months later. The girls were divided into three random groups. Afsari et al. (2015) stated that the

attitudes prior to the intervention were not significantly different in any of the three groups ($p>0.05$). Educating the girls only resulted in an increase in attitude improvement scores, significantly more than the mother only education group (95% confidence interval: 0.4 - 1.3).

Stress

“Don’t worry about anything; instead, pray about everything. Tell God what you need, and thank him for all he has done. Then you will experience God’s peace, which exceeds anything we can understand” Philippians 4: 6-7. According to Rodrigues, Michelin, Marchi, Schurhaus Hyeda, Schülter Buss Heidemann, & Gonçalves Nitschke (2015), women’s health promotion is a major source for social and personal development. When women are not able to continue to promote their overall health, stress develops. Health and fertility tend to be major stressors for many women. For women, stress may come in the form of an abnormal cycle with bleeding frequency issues, social and environmental factors, and things like smoking, exercise, and diet, as well as shift work, and menstrual related illness or disorders.

Abnormal Menstrual Patterns. Included in this literature review were three articles that discussed abnormal menstrual patterns (Nappi, Fiala, Chabbert-Buffet, Häusler, Jamin, Lete, Lukasiewicz, Pinitiaux, & Lobo, 2016; Hooff, Voorhorst, Kaptein, Hirasings, Koppenaal, & Schoemaker, 2004; & Cardigno, 2009). A major area of stress for women in regards to their menstrual cycles is bleeding frequency. A clinical study conducted by Nappi, Fiala, Chabbert-Buffet, Häusler, Jamin, Lete, Lukasiewicz, Pinitiaux, & Lobo (2016) explored women’s preferences for menstrual bleeding and what the level of inconvenience looked like for them. Nappi et al. (2016) compared women ($n=1319$) using combined hormonal contraceptives [CHC] and ($n=1564$ non-CHC). The reported frequency of preferred menstrual bleeding greatly varied.

Menstrual periods were substantially longer in length (5 days vs. 4.5 days), heavier (16% vs. 8%), and more symptomatic (6.1 vs. 5.6) among women not using CHC, compared to the CHC users with statistical significance ($p < 0.0001$). Over 50% of these women reported symptoms such as pelvic pain, bloating, and emotional distress, however it was higher in the non-HC group ($n=1564$). In these women's opinions, 57% agreed that they would prefer longer intervals between periods. Many factors affected their opinion, such as social life, work, sports, sexuality, and more; only 43% would opt to continue a monthly period.

Social & Environmental Factors. For this literature review, two articles looked at social and environmental factors affecting women (Liu, Gold, Lasley, & Johnson, 2004; Hooper, Bryan, & Eaton, 2011). Caffeine and smoking affects women's health (Liu, Gold, Lasley, & Johnson, 2004; Hooper, Bryan, & Eaton, 2011). Liu et al. (2004), examined women who smoked vs. women who did not, and found that current smokers age 35 and older had significant decrease in cycle length (-2.17 days, 97% confidence interval: -3.97, -0.37), particularly in regards to the follicular phase length; while women who were less than 35 years old and smoking, cycle length was not affected. One study examined how exercise and pain affected a woman during her menstrual cycle. In this study (Hooper et al., 2011), women ($n=117$) completed various exercise challenges during different times in their menstrual cycle and then rated their exertion and pain using different scale levels. It was found that there were significant changes in individual women during various times of their menstrual cycles. Use of hormonal birth control impacted their rating of perceived exertion [$F(2, 111) = 3.75, p < 0.05$] and perceived pain [$F(2, 110) = 3.31, p < 0.05$]. This means that women who were not using hormonal contraceptives had higher increase in activity exertion and pain compared to women who were using hormonal contraceptives and in different phases of their cycle. This shows that hormonal

contraceptive use and phase of cycle during exercise is greatly affected, so women may want to exercise at different times during their cycle, or be interested in hormonal contraceptives to help lessen their symptoms. Liu et al. (2004) compared women who consumed alcohol compared with those who did not. Women who consumed alcohol had significantly shorter (-1.26 days, 95% confidence interval: -2.21, -0.31) cycle lengths.

Shift work. One of the last components to explore in regards to stress on the body in relation to the menstrual cycle is shift work. For this literature review, three articles focused on shift work and its effects (Labyak, Lava, Turek, & Zee, 2002; Sasaki, Approbato, Maia, Fleury, Giviziez, C, & Zanluchi, 2016; & Tucci, Murphy, Boyland, Dye, & Halford, 2010). Shift work usually involves long hours, 12+ hours and “night shift” is usually considered working around the hours of 7pm to 7am. It is estimated that 15.2 million people in the United States work non-daytime hours, or for extended periods of time (Labyak, Lava, Turek, & Zee, 2002). Women make up over 46% of the workforce in America, and approximately 14% of women in this category are shift workers. This is about 30% of women who work in the U.S. are doing shift work.

In the recent study by Labyak et al. (2002), n=68 nurses (less than age 40) were recruited and evaluated on sleep, menstrual function, and pregnancy outcomes. 53% of women (n=36) reported menstrual changes such as irregularities, increased pain, and/or psychological symptoms ($p < 0.003$). Out of the 53% of women who reported menstrual cycle changes, the changes occurred with cycle length (22%), changes in menstrual flow (35%), increase in pain (18%), and changes in duration of bleeding (26%). Women slept less when working nights (5.9 hours +/- .3 hours on night shift, compared to 6.9 hours +/- .2 hours on day shift), had more sleep disturbances (n=68, 10.35, $p < 0.01$), and took longer to fall asleep ($p < 0.01$). 47% of women

(n=32) reported no changes in menstrual function as they did shift work. Women also reported that they had problems focusing at work (n=68, 4.39, $p<0.05$), increased occurrence of nervous/upset stomach (n=68, 4.09, $p<0.05$), and overall general malaise (n=68, 10.24, $p<0.01$). With reporting of varying pregnancy outcomes, it is important to note that women are experiencing a decline in fertility in the United States, as women are waiting longer to have children. It is estimated that 7% of American couples are infertile and 15% of people have some fertility disorder (Sasaki et al., 2016). Another interesting point to add is that the majority of women in this study (78%) were taking oral contraceptives (Labyak, 2002). This is interesting because it speaks to the fact that due to menstrual irregularities with shift work, many women are still having further side effects due to the shift work (even while taking contraceptives).

The use of oral contraceptives and night shift work is important as we explore eating habits that occur in correlation with shift work. Tucci, Murphy, Boyland, Dye, & Halford (2010) explored the relationship between food intake and oral contraceptives. This is important to look at as America has an obesity problem. Obesity has a relation to women taking oral contraceptives. Tucci et al. (2010) looked at 55 women taking OCP's and found that there was a significant effect on food intake ($F(1,53) = 7.8, p<0.01$). The study compared food intake in different phases of the menstrual cycle, and this concluded that overall, women ingested more calories during the luteal phase (294.8 +/- 20.9 kcal) vs. the follicular phase (250.3 +/- 16.6 kcal; $t(54) = 3.2, p<0.01$). It also concluded that flavor of food was affected, and women tend to eat more calories from sweet foods, compared to savory goods ($t(54) = 10.6, p<0.01$). This shows proper statistical significance in the fact that there is potential for women who are taking OCP's to gain more weight due to ingestion of more sweet, sugary food items.

Illness

When women are stressed over a period of time illness can develop. Illness in regards to women's health can take various forms. It may include breast cancer, issues with the uterus, or multiple other issues. Eleven articles discussed health issues that many women experience (Tehrani, Mostajeran, & Shahsavari, 2014; ACOG, 2017; Castillo-Martínez, López-Alvarenga, Villa, & González-Barranco, 2003; Adeniji, Essah, Nestler, & Cheang, 2016; Gonzalez, 2017; Hess, Litwiller, Byron, Stutsman, Kasper, & Learman, 2015; Wasiak, Filonenko, Vanness, Law, Jeddi, Wittrup-Jensen, Stull, Siak, & Jensen, 2013; Nelson, 2014; Jung, Park, Kim, Kim, Jee, Cha, Sull, Jun, 2017; Kazemi, Homayoni, & Sabohi, 2014; & Raisi Dehkordi, Hosseini Baharanchi, & Bekhradi, 2014). Two of the most common endocrine disorders affecting women of reproductive age is a condition called polycystic ovary syndrome [PCOS] and abnormal uterine bleeding [AUB] (Tehrani, Mostajeran, & Shahsavari, 2014).

PCOS. Four articles in this literature review discussed PCOS (Tehrani, Mostajeran, & Shahsavari, 2014; ACOG, 2017; Castillo-Martinez, López-Alvarenga, Villa, & González-Barranco, 2003; & Adeniji, Essah, Nestler, & Cheang, 2016). PCOS is a hormonal disorder affecting 10-15% of women (Tehrani et al., 2014). Women experiencing PCOS often present as being overweight, severe acne, oily skin, excess hair growth all over their body, and irregular patterns of menstruation (ACOG, 2017). In order to diagnose PCOS, there are a few criteria that needs to be identified, including hyperandrogenism (70% of women experience hirsutism) and/or hyperandrogenemia) and ovarian dysfunction (oligoanovulation and/or PCOS on ultrasound). In regards to PCOS, 30% of women with regular cycles (between age 25-30) have characteristics consistent with polycystic ovaries and 30% of women with PCOS do not display cystic ovaries. Proper assessment and evaluation need to be conducted on these women.

There are many comorbidities that are associated with PCOS. Because insulin plays a major role in PCOS, one can conclude that prediabetes and type 2 diabetes mellitus is a direct link. Approximately 30% of women with PCOS have impaired glucose tolerance [IGT], and 7% have diabetes. Management of PCOS and diabetes for these women takes multiple forms. It is not just a simple medication fix, but rather a lifestyle change. Up to 80% of women with PCOS are obese (ACOG, 2017, and women who are obese have higher chances of having menstrual cycle disturbances (Castillo-Martinez, López-Alvarenga, Villa, & González-Barranco, 2003). Weight loss (achieving approximately 10%), exercise, adequate diet and nutrition all work to restore normalcy of the menstrual cycle and its proper function.

Adeniji, Essah, Nestler, & Cheang (2016) explored combining oral contraceptives and PCOS. (N=30) women were evaluated. Women with PCOS (n=10) and (n=20) women who were the control in the experiment. It was found that initially all women (N=30) had comparable BMI. However, the women with PCOS were more insulin resistant at baseline as examined by the Matsuda index ($p=0.0092$) and HOMA-ISI ($p=0.0397$). Those with PCOS also displayed increased testosterone levels ($p=0.0021$), increased fasting insulin ($p=0.0495$) and elevated glucose levels ($p=0.0393$), elevated triglycerides ($p=0.0044$), and elevated waist-to-hip ratio ($p=0.0089$), as in compared to control women (n=20). These results showed statistical significance in the differences of PCOS women versus non-PCOS women (Adeniji et al., 2016).

A four month long, randomized, placebo controlled study focused on women with PCOS (n=80), group one was given metformin only, group two included metformin plus calcium and vitamin D, group three was received just calcium and vitamin D, group four was the placebo control (Tehrani et al., 2014). BMI, menstrual cycle regularity, hirsutism, acne, calcium, and vitamin D levels were all measured and compared. Results showed that hirsutism and acne

results were not any different. However, regular menstrual cycles were higher in groups one and two than in groups three and four, with statistical significance of ($p < 0.05$). This shows that metformin has a definite benefit to treating PCOS. While calcium and vitamin D alone may not help women with PCOS, adding them to supplement metformin may be result in greater benefit. This may be especially beneficial when considering many women need vitamin D supplementation due to low vitamin D levels (Tehrani et al., 2014).

Abnormal Uterine Bleeding. Another category that falls alongside of PCOS and menstrual cycle abnormalities and irregularities is abnormal uterine bleeding [AUB]. This literature review explored eight articles that studied AUB (Laughlin-Tommaso, Borah, & Stewart, 2015; Gonzalez, 2017; Hess, Litwiller, Byron, Stutsman, Kasper, & Learman, 2015; Wasiak, Filonenko, Vanness, Law, Jeddi, Wittrup-Jensen, Stull, Siak, & Jensen, 2013; Nelson, 2014; Jung, Park, Kim, Kim, Jee, Cha, Sull, & Jun, 2017; Kazemi, Homayoni, & Sabohi, 2014; & Raisi, Hosseini, & Bekhradi, 2014). AUB can be classified into two different categories. These include heavy menstrual bleeding [HMB] and intermenstrual bleeding [IMB]. Using these two terms works to reduce the amount of other terms (dysfunctional uterine bleeding, menorrhagia, functional uterine bleeding, hypermenorrhagia, hypomenorrhagia, menometrorrhagia, metrorrhagia, oligomenorrhagia, polymenorrhagia, uterine hemorrhage, or uterine fibroids (which can cause further issues such as dyspareunia (Laughlin-Tommaso, Borah, & Stewart, 2015) that are normally used when discussing AUB (Gonzalez, 2017).

In our society, today, it is estimated that women will experience HMB during their lifetime (Hess, Litwiller, Byron, Stutsman, Kasper, & Learman, 2015). HMB is classified as menstrual blood loss of 80mL or more during a menstrual cycle. However, when measured both objectively and subjectively, prevalence rates of HMB vary, impacting between 20-52% of

women. There were 13% of women in the United States reporting HMB who are ages 18-64 years old (Wasiak, Filonenko, Vanness, Law, Jeddi, Wittrup-Jensen, Stull, Siak, & Jensen, 2013).

Just as the link between PCOS and BMI showed correlation, the same is true for AUB and BMI. Average BMI for women experiencing AUB is between 29-30.2, which places these women in the obesity category (Nelson, 2014; Jung, Park, Kim, Kim, Jee, Cha, Sull, & Jun, 2017).

In the study by Kazemi, Homayoni, & Sabohi (2014) the comparison of quality of life in women with a hysterectomy vs. hormonal therapy due to AUB was evaluated.

Women (N=108) were split into two groups, (n=54) with hysterectomy, and (n=54) with hormone therapy. In the hormone therapy group, 83% of women used medroxyprogesterone acetate, and 17% used hormone pills. In the hysterectomy group, 91% had an abdominal hysterectomy, while 9% had a vaginal hysterectomy. After assessment about quality of life and side effects of each method, the results showed that the quality of life (including physical and emotional dimensions) in the group with hormone therapy (n=54) was higher than that of the hysterectomy group (n=54). It was statistically significant as ($p < 0.05$) demonstrated.

Even though hormonal contraceptives tend to be the first line in treating HMB and AUB, there are options for complementary alternative medicine [CAM]. Raisi, Hosseini, & Bekhradi (2014) looked at HMB and dysmenorrhea with the CAM therapy of lavender inhalation. In the study (n=96) women were split evenly into two groups (lavender oil & sesame oil) and (sesame oil only). It was found that women using lavender inhalation had decreased symptoms of dysmenorrhea, compared to the sesame oil only group ($p < 0.001$). When comparing the amount of menstrual bleeding based on sanitary towel usage during menstruation, the lavender group and

sesame oil only group showed no significant statistical difference ($p < 0.25$). This showed that while lavender may be an appropriate CAM treatment for dysmenorrhea, it is not proven to show results with helping HMB (Raisi et al., 2014).

This study showed that more goes into a hysterectomy than just taking care of the bleeding issue. There are important emotional and physical pieces that should be taken into consideration. Supplementation with hormone therapy may provide a better alternative than an invasive surgical procedure, and may also stabilize women in a healthier manner in relation to their mood.

Chapter IV: Discussion, Implications and Conclusions

The purpose of this literature review was to look at how the menstrual cycle is a vital sign of health for women. The menstrual cycle serves as a window into reproductive well-being and can be used as a vital sign for assessment of optimal health. The Johns Hopkins Research Evidence Appraisal Tool was used to choose 22 pertinent scholarly peer-reviewed articles. A critical review and appraisal for quality of each article is shown in the matrix. The articles were then appraised and studied for implications and deficiencies for a nurse-midwife practice. The appraisal and discussion also include a literature synthesis. The information presented will also show the need and opportunity for further research and development, integration and application of the theoretical framework. Knowledge and understanding of how the menstrual cycle depicts health in a woman will equip nurse-midwives with a valuable assessment tool that can easily be implemented into practice.

Literature Synthesis

The research question that is the foundation and inspiration for this literature review is as follows: How is the menstrual cycle a vital sign and predictor of optimal health in women? A great deal of knowledge and understanding was obtained about what factors constitute a normal cycle and what is considered outside of normal. Determining factors about how this applies to age and stage of life development were also uncovered. A significant number of articles overlap information about the signs and symptoms of fertility, ovulation, and menses as it relates to optimal health. It was very pertinent to acknowledge and differentiate normal from abnormal. Articles and discussion includes self-reporting feelings, attitudes about menses, normal changes in fertility spanning a lifetime of reproductive years, and how this pertains to the onset of menarche, childbirth and perimenopause. It is imperative that this review include the signs and

symptoms of disease and hormone dysfunction and how this is represented in the menstrual cycle. Lifestyle factors like stress, BMI, sleep, nutrition, exercise and shift work greatly affect fertility and are expressed in the menstrual cycle. Reproductive disease includes amenorrhea, infertility, anovulation and abnormal uterine bleeding. These conditions can be identified through fertility awareness. It was also shown that fertility awareness has a significant implication and application in third world countries and it is vital to round out the discussion to include those.

Amenorrhea

The literature tells us that women experiencing stress are at higher risk and more likely to have abnormal or absent menstrual cycle patterns (amenorrhea). These influences come from stress on the body through things like smoking, exercise, shift work, or illness. According to Bae, Park, & Kwon (2018), “a regular menstrual cycle is an important indicator of a healthy reproductive system” (p. 1). One of the most influential factors affecting the menstrual cycle is stress. Stress can take many forms on the body. It may look like a medical condition related to the menstrual cycle; or it could be diet, over-exercise or lack of exercise, or abnormal work hours (shift work) and poor sleeping patterns.

Stress affects the menstrual cycle in many ways, but most often appears in the form of irregular periods and early menopause. Irregularity or absence of menstrual cycles can be a warning sign to women that something may not be adequately functioning within the body. Once pregnancy is ruled out, it is necessary to explore a possible underlying cause. Women often go through many different periods of stress throughout their life. Whether it is personal, work related, family issues, health, relationships, or whatever else, it appears there is always something to be concerned or worried about. Women who often have irregular cycles stress

about the irregularity, and in turn become more stressed. While it can be difficult to not get upset about these issues, it is important to realize that there is only so much control a woman can have over her body. Diet, exercise, and a positive attitude can go a long way in a person's health. It is important as women's healthcare providers that we provide wellness and health promotion counseling at all visits.

While women's attitudes about menstruation are diverse and complex, it is necessary to ask patients what they prefer and why. This provides a better understanding into concerns or problems they may be experiencing. While some women believe, bleeding is unpleasant and affects their life, other women view it as unhealthy to not have a monthly period, as they believed the body needs to cleanse itself and it is evidence of not being pregnant (Nappi et al., 2016).

Based on the hypothalamic-pituitary-ovarian axis, there is much regulation that the body must do to in order to coordinate cycles and regulate a pattern each month. Irregular menstrual cycles in the first five years of menarche are considered to be a normal physiological nature, thus do not warrant a reason for intervention.

Another consideration that women might struggle with, in addition to amenorrhea and abnormal cycles, are the effects of shift work. Working long shifts, or night shift is extremely taxing on the body. It can affect a person mentally, emotionally, and physically. It is a demanding shift to work, and many sacrifices are made to get through these shifts.

Studies conducted have been among nurses who engaged in shiftwork and focused on sleep, fatigue, mental health concerns (stress & anxiety), and cardiovascular disease. In terms of women's health, increased menstrual cycle irregularities, more painful periods have been associated to shift work, as well as increased risk for miscarriage, preterm birth, and low birth

weight babies in women who work irregular hours for extended periods. Women who worked these irregular hours were more likely to have medical interventions due to menstrual disturbances, than those who did not do shift work.

The literature explains how the exact pathophysiology of PCOS is characterized by ovarian enzyme dysregulation. This involves two types of cells; the theca cells and the granulosa cells. These cells encompass the oocyte during development. Insulin also plays a significant role in PCOS, as insulin works to stimulate the ovaries with estrogen and androgen (Gonzalez, 2017). In a woman with PCOS, insulin resistance leads to anovulation (the absence of ovulation) which is why many women with PCOS struggle with irregular cycles and infertility.

One element that is important for women to realize is that having PCOS predisposes them to having diabetes later in life, especially if there is a family history of diabetes. Providers can help women not to feel discouraged or ashamed if they are diagnosed with PCOS. Midwives are able to come alongside these women with a positive approach and co-management style with a physician if necessary. Shame and guilt associated with PCOS (or any medical issue) should not cause more stress in a woman's life. Nurse-midwives have the opportunity to approach patients with care and compassion to properly treat these women.

Abnormal uterine bleeding [AUB] can be defined as "bleeding from the uterine corpus that is abnormal in duration, volume, and/or frequency" in the form of acute or chronic for greater than 6 months (Hess et al., 2015, p. 218). The reasoning for AUB could include premature ovarian failure, STI's, bleeding disorders, endocrine disorders, trauma, chronic illness, or others. The treatment of AUB could include oral contraceptives, hormone therapy, IUD, endometrial ablation, or other surgical procedures. The burden of heavy menstrual bleeding

[HMB] can be great on some women, as it has the potential to affect activities of daily living (Wasiak et al., 2013).

Infertility

The literature describes many factors affecting fertility and subsequently the condition of infertility. Assessing and identifying the signs of normal ovulation is an essential factor in identifying the etiology of infertility. Fertility awareness by the woman is one of the foundational building blocks to discovering the root cause of infertility. Just prior to ovulation, hormonal changes are rapid with a 30%-50% change per day (Blackwell, et al., 2013). This rapid change makes it imperative for women to monitor their fertility daily in order to maximize their window of fertility. Self-reported bleeding patterns as regular or irregular, without additional information, is not an accurate representation of ovulation. In the study done by Blackwell et al., (2013), of the 113 reportedly normally cycling women, only 91 were found to have had ovulation that could have resulted in a pregnancy. In addition, 22 other women were found to have a luteal phase defect which has a direct effect on maintaining a very early conception. Liu, Gold, Lasley & Johnson, (2004) states that self-reported bleeding patterns cannot determine or distinguish ovulation nor can it be used to determine the timing of the next cycle or ovulation. Women in yet another study done by Reinaldo et al., (2016) who stated having normal, regular cycles were not all found to have normal ovulation. Of the 199 women studied who state having regular cycles, only 113 had an ovulation that could be proven with ultrasound.

Women who desire to achieve pregnancy can increase their success by becoming acutely aware of the signs of ovulation as discussed at length in chapter three. Briefly recapping the three most prevalent signs are: 1. Increased amount of cervical mucus, 2. cervical mucus that is

clear stretchy and lubricative, 3. An upward shift in basal body temperature just as ovulation has occurred and until the end of the cycle. Other signs and symptoms that ovulation is/has occurred are softening of the cervix, change in the position of the cervix, slight dilation of the cervical opening, vaginal sensation of wetness and mittelschmerz pain. Identifying reproductive disorders can begin even in adolescence with a menstrual log. Even a simple menstrual log aids the discussion and assessment of abnormal bleeding, abnormal cycle length and the presence or absence of the signs of ovulation (Popat, Prodanov, Callis & Nelson, 2008). It is imperative that nurse-midwives are trained to teach their clients fertility awareness signs. A significant part of the midwife client relationship is empowerment, so fertility awareness is a skill we can provide all patients we care for.

The absence of the signs of ovulation are indicative that ovulation has not occurred which implies an underlying medical issue that needs further evaluation. The benefit of utilizing fertility awareness with infertility is that the treatment begins with resolution of the underlying cause. When using assisted reproductive technology (ART), the goal is not necessarily to treat the underlying issue but to potentially forego that issue and coerce the body into a pregnancy. ART has many downsides, it is cost prohibitive for many people, time consuming with multiple appointments, can have a high failure rate and use of methods that many people feel are unethical. Fertility awareness often times brings to light the underlying issue without having to undergo expensive, time consuming diagnostic tests. The Creighton Model Method states that 98% of women who have experienced infertility (one year of unprotected intercourse) are able to achieve pregnancy within 6 months using their fertility awareness program (Hilgers, 2010).

Cochrane, Smith, Possamai-Inesedy and Bensoussan (2016) states that fertility awareness significantly improves the success of those seeking pregnancy. In their study discussing the benefits of acupuncture and achieving pregnancy, those who received acupuncture treatments heightened their fertility awareness by 86% and were able to achieve pregnancy in 5.5 weeks. They also reported an overall sense of health and well-being. In the control group of lifestyle modification only, it took 10.67 weeks to achieve pregnancy and did not report an increased sense of health and well-being.

Blackwell et al., (2013); Cochrane, Smith, Possamai-Inesedy & Bensoussan (2016); Hilgers, (2010); Hoof et al., (2004); Liu, Gold, Lasley & Johnson, (2004); Reinaldo et al., (2016); Tehrani, Mostajeran & Shahsavari (2014); Vigil et al., (2017); all agree that lifestyle choices and general health and well-being greatly affect ovulation and ultimately fertility.

Birth Control

The literature presented shows a broad variety in the beliefs about birth control. While illnesses that women experience like PCOS and AUB may be controlled and treated with birth control, such as oral contraceptives (Goodman et al., 2015); it also shows that natural family planning [NFP] has been shown to be one of the most effective forms of birth control worldwide when used correctly (NFPTA, 2017). It is important for nurse-midwives to understand and be able to teach fertility awareness. Not only is it cost effective but also empowers women to learn about how their body functions.

Birth control also presents with multiple side effects due to the influence of hormones. These include increases in appetite for sweet food related items, consuming a larger percentage of energy from fat, and associated weight gain. Women who use oral contraceptives are also

decreasing their natural ovarian fluctuations, and may have more side effects due to that suppression (Tucci et al., 2010).

While there was no exploration in how birth control affected the menstrual cycle in great depth (because that could have been an entire capstone), the literature did demonstrate that ovulatory dysfunction was not influenced either in a positive or negative way when in combination with oral contraceptives (OC). Ovulatory dysfunction found before OC use was still present after discontinuation of OC. In fact, the best treatment for obesity and PCOS patients is not OC like some may think, but rather weight loss should be the standard first line of treatment (Hooff, 2004).

Developing Country Disparities

The World Health Organization (WHO) released a statement on February 13, 2018 that “Family planning is considered a development “best buy” and a life-saving intervention for millions of women and girls”. This is in reference to a new education program that covers the different types of contraception and helps women make a choice for family planning. Over two million women and girls worldwide in their childbearing years have a strong desire to postpone pregnancy but are not using modern contraceptive methods (or effective natural family planning methods). This is considered an “unmet need”, where there is a desire to avoid pregnancy but are still engaging in sexually intercourse. Groups of women with high numbers of unmet needs are adolescents, migrants, urban slum dwellers, refugees and those in the postpartum period (WHO.org, 2018). There are a multitude of reasons why these women are not using contraception. Some of them are; 1. cost, 2. Availability, 3. Access, 4. Ease of use, 5. Cultural barriers, and 5. Spiritual/religious barriers (WHO.org, 2018). The methods most commonly

recommended by the WHO are hormonal contraception which is largely dependent upon and available only through donations by other nations.

Fertility awareness and subsequently natural family planning can be an invaluable resource for women worldwide, especially to poor and underdeveloped nations who depend on the generosity of other nations to assist in family planning services, supplies and education. Using fertility awareness, or natural family planning, could resolve many of the barriers that stand in the way of family planning; cost, access, availability, cultural and spiritual barriers. It also eliminates the need for follow up appointments, side effects, refills, low supply issues, equality access and availability. According to the Family Planning 2020 (FP2020) committee, 34% of women still do not have equal access to hormonal contraception (FP2020.org, 2016).

Indian women have recently been able to access a free app called *Cyclebeads*. Cyclebeads is the only free app available to Indian women written in Hindi that has the application of both achieving and avoiding pregnancy (FP2020.org, 2016). Cyclebeads is based on the Standard Days Method and works best for women with cycle lengths that are 26-32 days long. Researchers from the Georgetown University's Institute for Reproductive Health in New Delhi have a strong interest in studying the usage and impact this modern contraceptive method has on the women of India. The Cyclebeads method has been used by over five million women in over 60 countries, was classified as a modern contraceptive method and was tested and found to have a 95% perfect use effectiveness rate and typical use of 88% (FP2020.org, 2016). "This type of modern contraceptive method can help address a huge unmet family planning need for women" (FP2020.org, 2016).

Recommendations for Future Research

Gaps in current research were identified throughout the process of writing this paper. There is a need for current research to further study the fertility cycle and its effects on the health of women. Some of the valuable information about fertility awareness, ovulation, ovulation detection and cyclic bleeding (without the influence of hormonal contraception) is almost 20 years old. There is also very little replication of this valuable research within the current medical community. Also missing is current comparative research between hormonal contraception and fertility awareness methods for family planning. Our knowledge about the reproductive system, technology, medical care and treatments have grown immensely and yet research for fertility awareness has not continued at the same pace. Research in this area is vital for providers and women so that more knowledge is gained in the face of medical advances and have continued opportunities to support and work towards reproductive health.

All women who have a menstrual cycle benefit from studying fertility awareness. Even if that woman is done having children, even if they never bear a child, whether or not they are sexually active and even if they have used hormonal contraception. At any given time, the CDC states that about 25% of women in their childbearing years are using hormonal contraception (Reproductive Health, 2017). That leaves 75% of the female population in this country at any given time who are not using hormonal contraception but are still cycling. Every woman could benefit from current and up to date research about the menstrual and fertility cycle. By not fervently studying fertility awareness, every woman loses and we miss the opportunity to empower women with the ability to optimize self-care, self-awareness and knowledge about their bodies starting at an early age.

Integration for Dorothea Orem's Nursing Theory

Dorothea Orem's nursing theory focuses on self-care and provides a framework with which to practice midwifery. Her belief was that when people are able to identify their needs, and care for themselves, it is the natural progression of development and maturation of self. The goal is to achieve the fullest, richest, most optimal life possible for that person. One of Orem's essential requirements for the art of practicing was to develop a personal relationship between the nurse, the patient, the patient's relatives, friends, associates, family, and all others concerned about the well-being of the patient. This directly impacts the midwifery model of care in promotion of the whole woman and family centered care.

The pearls of midwifery call us to look at fertility in its own beauty and as a normal physiologic process. In the absence of complications, midwives are advocates for non-intervention and health promotion. Fertility awareness is a natural progression of self-care and is best utilized as a partnership between provider and woman. The methods of fertility awareness are first taught to the woman by her provider, then she observes the signs on her own and then comes back to provider in a shared relationship to discuss the findings. These roles are well defined and allow for flexibility in stages of development and stages of life. These roles work well within the framework Orem laid out, can be articulated by the nurse, and assist the woman in achieving a higher level of self-care.

Conclusion

The purpose of this review was to explore how the menstrual cycle is a vital sign of women's health. Using the Johns Hopkins Research Evidence Appraisal Tool, 22 scholarly peer-reviewed articles were appraised and researched in depth. The articles were studied and evaluated in depth for implications into nurse-midwife practice. The information presented

shows the need and opportunity for further research and development, integration and application of the theoretical framework of this topic. This review will inform nurse-midwives and other healthcare professionals to recognize the importance of the menstrual cycle, as well as educate and care for women in a more proper manner.

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Appendix

| <i>Citation, Level, & Quality</i> | <i>Purpose of Study</i> | <i>Sample/ Setting</i> | <i>Design</i> | <i>Measurements</i> | <i>Results/ Conclusions</i> | <i>Authors' Recommendations</i> |
|--|---|---|---------------|--|---|---|
| <p>Hooper, A. C., Bryan, A. D., & Eaton, M. (2011). Menstrual cycle effects on perceived exertion and pain during exercise among sedentary women. <i>Journal Of Women's Health (15409996)</i>, 20(3), 439-446. doi:10.1089/jwh.2010.2042</p> <p>Level I</p> <p>Quality: Good</p> | <p>The purpose of this study was to examine the influence of the menstrual cycle and what it has on hormonal contraceptive (HC) use, as well as the response to moderate intensity exercise among previously sedentary women.</p> | <p>Sample (n= 117) women were included. 73 women (62%) were not using any hormonal birth control, & the remaining 44 (38%) served as controls. Participants were 18-45 years old & recruited from the Denver metro area & the University of Colorado through electronic ads on campus, Craig's list, Facebook and flyers. Participants were excluded if for varying reasons (see pg. 441 in article).</p> | <p>RCT</p> | <p>BMI was computed using a ratio of body mass to height. Age and ethnicity were also recorded. Physical activity/week was measured using the interviewer-administered Stanford Seven-Day Physical Activity Recall. Women were given a calendar & asked to report the date of onset of their most recent period. A forward method was used to calculate their menstrual cycle day on the day of the challenge session.</p> <p>Women completed treadmill exercise during 3 different phases of the menstrual cycle & rated their exertion & pain using Borg's Rating of Perceived Exertion (RPE) and CR10 scales at 10, 20, and 30 minutes during the exercise session.</p> | <p>Tests indicated that the effect of menstrual phase was again significant among women not using HCs (menses: mean = 0.4, SD = 0.84; nonmenses: mean = 0.16, SD = 0.54, p<0.01) but not significant among controls (p = 0.31). Women not using HCs in the early follicular phase experienced an increase in pain, whereas every other group experienced no change or a decrease in pain (r= -0.295, p = 0.379) Overall, cycle phase influenced the psychological response of sedentary women to moderate intensity exercise, but only among those not using HCs.</p> | <p>With results of the hypothesis confirmed, by only one additional article, another larger study should be conducted Dysmenorrhea was not directly measured, and therefore cannot rule out the possibility that the women in the early follicular phase were suffering from painful periods, which can influence performance. Perhaps dysmenorrhea should be looked at in another study correlating with this.</p> |

| <i>Citation, Level, & Quality</i> | <i>Purpose of Study</i> | <i>Sample/ Setting</i> | <i>Design</i> | <i>Measurements</i> | <i>Results/Conclusions</i> | <i>Authors' Recommendations</i> |
|--|--|--|---------------|--|---|--|
| <p>Cochrane, S., Smith, C. A., Possamai-Inesedy, A., & Bensoussan, A. (2016). Prior to conception: The role of acupuncture protocol in improving women's reproductive functioning assessed by a pilot pragmatic randomised controlled trial. <i>Evidence-Based Complementary & Alternative Medicine (Ecam)</i>, 1-11. doi:10.1155/2016/3587569</p> <p>Level I</p> <p>Quality: Good</p> | <p>There were two purposes of this study.</p> <p>1.) is to provide acupuncture to women with sub/infertility in order to increase their awareness of their fertility and achieve normalization of their menstrual cycle compared with lifestyle as a control.</p> <p>2.) is to compare acupuncture with lifestyle changes to identify length of time from entry into study until conception.</p> | <p>Sample included 56 women ages 18-44 years old who had been actively trying to conceive without success for at least 12 months, & those who had a gynecological diagnosis of infertility. Participants were recruited in Sydney, Australia between Oct. 2009-Dec. 2011 from the research center, social media networks, & local advertising. Participants were excluded if for varying reasons (see pg. 2 in article).</p> | <p>RCT</p> | <p>Multiple measurements were utilized to attempt to achieve normalization of the menstrual cycle, include CSIRO Total Wellbeing Diet, exercise regimes (meditation, yoga, Tai Chai, walking), limiting alcohol & smoking, & acupuncture. BBT charting was used for menstrual normalization documentation. Measure Your Medical Outcome Profile (MYMOP) was used to measure quality, as a questionnaire, as well as a quantitative data analysis using IBM software.</p> | <p>There was a statistically significant increase in fertility awareness in the group of women who received acupuncture, compared to those who only did lifestyle adjustments</p> <p>There was no significant change in menstrual regularity over time between the two groups; except participants receiving acupuncture trended toward retaining menstrual cycle regularity over 3 cycles whereas the lifestyle only group lost regularity in cycles</p> <p>Those receiving the acupuncture conceived on average in 5.5 weeks compared to 10.67 weeks with the lifestyle only group</p> <p>Most additions were found to be not statistically significant, such as changes in symptoms, conception time, etc. as ($p > 0.05$)</p> | <p>-Based on results, a stronger study would be larger and include around 200 women</p> <p>-There is a lot of potential for acupuncture to influence women's reproductive lives, but would require modification of a study (for credibility)</p> |

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|--|--|---|---------------|---|--|--|
| <p>Tucci, S., Murphy, L., Boyland, E., Dye, L., & Halford, J. (2010). Oral contraceptive effects on food choice during the follicular and luteal phases of the menstrual cycle. <i>Appetite</i>, 55(3), 388-392. doi:10.1016/j.appet.2010.06.005</p> <p>Level I</p> <p>Quality: Good</p> | <p>To examine how food ratings & energy intake from snack foods are influenced by menstrual cycle and use of OCP's. It was hypothesized that total caloric intake would be greater in the luteal phase. With regard to OCP's, given their reported effects on body weight, it was predicted that those currently taking OC may show hyperphagia.</p> | <p>55 females, ages 18-24 were recruited using opportunity sampling. Eligibility included regular menstrual periods of 28-32 days, absence of major health issues, no additional medication, no weight-loss/diets, no history of eating disorders, and not pregnant. 26 women were non-OCP group and 29 women were the OCP user group. This study was approved under the School of Psychology ethics committee in the UK.</p> | <p>RCT</p> | <p>Mixed-factor design with 2 participant factors: menstrual phase (luteal & follicular) and food type (sweet or savory). A screening questionnaire was used in this study and participants were tested at varying times using hedonic rating scales for each food offered and these consisted of a 5-point bipolar response scale.</p> | <p>-There was statistical significance on food intake as ($p < 0.01$) and it was noted that participants ingested more calories during the luteal phase (294.8 +/- 20.9 kcal) than the follicular phase (250.3 +/- 16.6 kcal; $t(54) = 3.2$, $p < 0.01$)</p> <p>-When offered snack foods, participants did eat significantly more calories in total in this pre-menstrual period.</p> <p>-Participants ate approx. 15% more calories during the luteal phase vs. the follicular phase.</p> <p>-The study showed that participants taking OCP's may have demonstrated hyperphagia.</p> <p>-There is no statistical significance in age or BMI groups, as well as food flavor.</p> | <p>- Results showed that this study had adequate sample size to detect an effect of menstrual cycle on snacking, however it was not sufficient to detect the more subtle effects of OC use. A larger study, with 384 participants per group would be needed.</p> |

| <i>Citation, Level & Quality</i> | <i>Purpose of Study</i> | <i>Sample/ Setting</i> | <i>Design</i> | <i>Measurements</i> | <i>Results/ Conclusions</i> | <i>Authors' Recommendations</i> |
|--|--|---|--|--|--|---|
| <p>Cardigno, P. (2009). Homeopathy for the treatment of menstrual irregularities: a case series. <i>Homeopathy</i>, 98(2), 97-106. doi:10.1016/j.homp.2009.01.004</p> <p>Level VI</p> <p>Quality: Good</p> | <p>To evaluate the usefulness of homeopathic treatment in the care of menstrual cycles that are irregular.</p> | <p>18 women with menstrual irregularities, ages 16-45 who regularly recorded all menstrual cycles. Women included had no more than 7 menstrual cycles/year. Patients were followed for 12months-13 years. Studied conducted in Italy.</p> | <p>Qualitative Experimental Research</p> | <p>Patients were treated with homeopathic medications and patient information was recorded with a software program- Radar and Winchip.</p> <p>Participants were divided into 4 groups, based on their clinical diagnosis.</p> <p>Measurement and graph charting recorded the symptoms of hormonal activity in all women.</p> | <p>Outcomes were both positive and negative And there was not unilateral improvement or worsening in women's cycles with homeopathic treatment, although homeopathic treatment can be useful Menstrual cycle was kept regular both when homeopathic medicine was discontinued and when it is continued (based on certain patient cases) Classical homeopathy could be a valid alternative to HRT</p> | <p>No author recommendations were given for this study.</p> |

| <i>Citation, Level & Quality</i> | <i>Purpose of Study</i> | <i>Sample/ Setting</i> | <i>Design</i> | <i>Measurements</i> | <i>Results/ Conclusions</i> | <i>Authors' Recommendations</i> |
|---|--|--|---------------|--|---|---|
| <p>Tehrani, H. G., Mostajeran, F., & Shahsavari, S. (2014). The effect of calcium and vitamin D supplementation on menstrual cycle, body mass index and hyperandrogenism state of women with polycystic ovarian syndrome. <i>Journal Of Research In Medical Sciences, 19(9)</i>, 875-880.</p> <p>Level I</p> <p>Quality: Good</p> | <p>The aim of this study is to evaluate the influence of calcium and Vitamin D supplementation on the regularity of menstrual cycles, body mass index (BMI) and hyperandrogenism in women with PCOS.</p> | <p>80 women, ages 20-40 with PCOS were evaluated for 4 months & randomly put into four groups. Groups included: 1-Receiving metformin (group 2- Metformin plus calcium, & Vitamin D 3-Calcium and Vitamin D 4-Placebo</p> <p>Women were referred to obstetrics & gynecology clinic of Alzahra hospital in Iran from July to December 2013</p> | <p>RCT</p> | <p>Measurements including BMI, physical exam, venous blood sampling, & ovarian transabdominal sonography were analyzed using SPSS software and Post-hoc Scheffe testing.</p> | <p>-Values were similar for hirsutism & acne ($p > 0.05$), frequency of acne in group 1 after metformin was statistically significant with a p value of ($p < 0.001$) and frequency of hirsutism decreased significantly in group 2 with ($p = 0.05$). -Results indicated that Vitamin D and calcium supplementation in addition to metformin therapy in women with PCOS could result in better outcome in a variety of PCOS symptoms including menstrual regularity, ovulation, some features of hyperandrogenism (hirsutism) and BMI.</p> | <p>Author spoke to the current study having a small sample size, lack of follow up period, and a short study duration; these are things to consider in studies going forward with this topic.</p> |

| <i>Citation, Level & Quality</i> | <i>Purpose of Study</i> | <i>Sample/ Setting</i> | <i>Design</i> | <i>Measurements</i> | <i>Results/ Conclusions</i> | <i>Authors' Recommendations</i> |
|--|--|---|---------------|--|--|---|
| <p>Raisi Dehkordi, Z., Hosseini Baharanchi, F. S., & Bekhradi, R. (2014). Effect of lavender inhalation on the symptoms of primary dysmenorrhea and the amount of menstrual bleeding: A randomized clinical trial. <i>Complementary Therapies In Medicine</i>, 22(2), 212-219. doi:10.1016/j.ctim.2013.12.011</p> <p>Level I Quality: High</p> | <p>To explore the effect of <i>Lavandula angustifolia</i> (lavender) inhalation on the symptoms of dysmenorrhea and the amount of menstrual bleeding in women with primary dysmenorrhea.</p> | <p>Participants included 96 female students residing in dormitory at Tehran University of Medical Sciences in 2011. Women suffered from level two or three dysmenorrhea according to the verbal multi-dimensional scoring system.</p> <p>Participants must have the following: be single, suffering from primary dysmenorrhea, no genital organs disorder, no systemic disease, have regular menstrual cycles, & not using contraceptives. The follow-up time was 4 menstrual cycles.</p> | <p>RCT</p> | <p>Participants were randomized into two groups: experimental ($n = 48$) who inhaled lavender based on sesame oil, and placebo ($n = 48$) who inhaled sesame oil only.</p> <p>The severity of dysmenorrhea symptoms was measured through a questionnaire, and the amount of menstrual bleeding was measured by sanitary towel usage.</p> | <p>- The symptoms of dysmenorrhea were significantly lowered in the lavender group compared to the placebo group ($p < 0.001$).</p> <p>-The amount of menstrual bleeding in the lavender group was reduced, compared to the placebo group (1.4x), however the difference was not statistically significant ($p=0.25$). No significant difference was observed for blood clots ($p=0.666$) either.</p> <p>-Research shows that lavender inhalation was effective in alleviating dysmenorrhea symptoms, it has no side effects and cost effective.</p> | <p>Authors suggested to conduct future trials with crossover design in order to recognize the effect of lavender inhalation on dysmenorrhea more clearly.</p> <p>Future studies need to discover inhalation effect mechanism of essential oils extracted from lavender and other plants</p> |

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|---|--|---|---------------|--|---|---|
| <p>Wasiak, R., Filonenko, A., Vanness, D. J., Law, A., Jeddi, M., Wittrup-Jensen, K. U., Stull, D. E., Siak, S., & Jensen, J. T. (2013). Impact of estradiol valerate/dienogest on work productivity and activities of daily living in women with heavy menstrual bleeding. <i>Journal Of Women's Health (15409996)</i>, 22(4), 378-384. doi:10.1089/jwh.2012.3633</p> <p>Level I</p> <p>Quality: Low</p> | <p>To assess the change in work productivity and activities of daily living in North American women with heavy menstrual bleeding (HMB) treated with estradiol valerate (E2V)/dienogest (DNG) compared to placebo.</p> | <p>190 Women in the US & Canada, ages 20-53 with a diagnosis of HMB. 120 women were given E2V/DNG and 70 women were given the placebo. Women were given this for 7 cycles/196 days.</p> | <p>RCT</p> | <p>Main outcome measures included work productivity and activities of daily living measured using a modified Work Productivity and Activity Impairment Questionnaire (mWPAI) on a Likert scale from 0 to 10 (higher values denote higher impairment levels).</p> | <p>No Significant differences were noted between treatment and placebo groups for HMB. E2V /DNG patients had a significantly higher mean MBL reduction (353mL to 130mL with a p < 0.0001). -Monthly gains due to E2V/DNG treatment associated with improvement in work productivity were estimated to be between \$50-80 and those associated with improvement in activities of daily living were estimated to be between \$60-\$80. E2V/DNG were shown to have a consistent positive impact on work productivity & ADL's in U.S. and Canadian women with HMB.</p> | <p>Observational studies in women with self-reported HMB (as opposed to clinical trials assessing HMB confirmed with objective measures) are needed to confirm our finding in the real-world setting. This has the potential to provide better data and research results.</p> |

| <i>Citation, Level & Quality</i> | <i>Purpose of Study</i> | <i>Sample/ Setting</i> | <i>Design</i> | <i>Measurements</i> | <i>Results/ Conclusions</i> | <i>Authors' Recommendations</i> |
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| <p>Sasaki, R. S. A., Approbato, M. S., Maia, M. C. S., Fleury, E. A. de B., Giviziez, C. R., & Zanluchi, N. (2016). Patients' auto report of regularity of their menstrual cycles. Medical history is very reliable to predict ovulation. A cross-sectional study. <i>JBRA Assisted Reproduction</i>, 20(3), 118–122. http://doi.org/10.5935/1518-0557.20160027</p> <p>Level IV</p> <p>Quality: Low</p> | <p>The aim of this study was to assess if the information on menstrual regularity is consistent with the assessment of the presence or absence of ovulation in women.</p> | <p>228 women ages 18-38, suffering from infertility for at least 1 year. Patients were divided into two groups: those who reported having a regular cycles (199 women) & those who reported an irregular cycles (29 women). The study was conducted at the Human Reproduction Laboratory of the University Hospital in association with the Brazilian Public Healthcare System.</p> | <p>Cross Sectional Study</p> | <p>Ultrasound monitoring, labs, questions, medical diagnoses, smoking, and alcohol use were all assessed. Data was taken and assessed using multiple tests.</p> <p>The test to evaluate the correlation between the cycle of regular reporting and presence or absence of ovulation, was the Fischer's test.</p> | <p>-199 patients who reported having regular menstrual cycles, 113 (57.78%) had proven ovulation upon ultrasound monitoring and 86 (42.22%) patients did not ovulate. Among the 29 patients who reported irregular cycles, 24 (82.76%) did not ovulate at the cycle monitoring.</p> <p>- Patients who self-reported having irregular cycles had more than six times the likelihood of not ovulating in a menstrual cycle (6.307 odds ratio), and a p value statistically significant with (P < 0.0001) and this could be a major factor into infertility concerns.</p> | <p>No author recommendations were given for this study.</p> |

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| <p>Liu, Y., Gold, E., Lasley, B., & Johnson, W. (2004). Factors affecting menstrual cycle characteristics. <i>American Journal Of Epidemiology</i>, 160(2), 131-140.</p> <p>Level II</p> <p>Quality: Good</p> | <p>To examine the effects and potential interactions of lifestyle and demographic factors on menstrual cycle characteristics.</p> | <p>338 women, ages 20-44 years old from California and Utah provided information on multiple menstrual cycles, completed diary logs, and urine samples.</p> | <p>Prospective Cohort Study</p> | <p>Multiple measurements including age, ethnicity, BMI, education, smoking, alcohol, caffeine, and physical activity were all assessed and measured. Participant diary logs and a linear mixed model showed measurements.</p> | <p>Over 943 cycles, p value shows statistical significance with ($p < 0.01$) for cycle length, although not for follicular phase or luteal phase length. Mean cycle length didn't vary by BMI, smoking, or physical activity. Results indicate that demographic and lifestyle factors are associated with menstrual cycle characteristics and that the patterns are similar whether outcomes are examined as continuous or dichotomous variables. These results also show that host factors, like ethnicity, smoking, physical activity, and alcohol use, may affect menstrual cycle outcomes. Therefore, both genetic and environmental factors may influence these characteristics, which in turn are related to long-term disease risk.</p> | <p>There may be a small bias in the study because 29 women were excluded from the study due to anovulatory cycles.</p> |

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| <p>Nappi, R. E., Fiala, C., Chabbert-Buffet, N., Häusler, G., Jamin, C., Lete, I., Lukasiwicz, M., Pintiaux, A., & Lobo, P. (2016). Women's preferences for menstrual bleeding frequency: results of the Inconvenience Due to Women's Monthly Bleeding (ISY) survey. <i>European Journal Of Contraception & Reproductive Health Care</i>, 21(3), 242-250. doi:10.3109/13625187.2016.1154144</p> <p>Level III</p> <p>Quality: Good</p> | <p>The aim is to assess the level of inconvenience associated with monthly bleeding, and to determine how many women would prefer a bleeding frequency of less than once a month, and what would motivate their choice. Birth control groups in this study included combined hormonal contraception (CHC), non-hormonal contraceptives or no contraceptives (non-HC group). Specific birth controls were not listed.</p> | <p>2883 women, ages 18-45 in six European countries (Austria, Belgium, France, Italy, Poland & Spain) took a 15-min quantitative online survey.</p> | <p>Quantitative Research Study</p> | <p>A standardized, structured questionnaire titled “The Inconvenience Due to Women’s Monthly Bleeding Study” with pre-specified response formats included various questions about menstrual cycles, medications, social life, and more.</p> | <p>1319 women used CHC, 1564 women used non-HC. Menstrual periods were significantly longer (5 vs. 4.5 days), heavier flow (16% vs. 8%) and more symptomatic (6.1 vs. 5.6) in non-HC users than CHC users (p < 0.0001). Over 50% of women in each group had pelvic pain, bloating, swelling, mood changes, but rate was higher in non-HC group. Results indicated that the majority of women in this study would prefer to have menstrual periods less than once a month, with a frequency ranging from once every 3 months to no periods at all. This can be explained by the desire to avoid the unpleasant aspects of menstruation and its negative impact on private and professional life.</p> | <p>More large-scale studies should be conducted to evaluate the effects of the use of extended-cycle CHCs on a variety of women’s health concerns. It would also be interesting to compare extended dosing of CHCs and long-acting reversible contraceptives. Finally, the most suitable cycle length for extended regimens could also be investigated.</p> |

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| <p>Hooff, M. V. (2004) Predictive value of menstrual cycle pattern, body mass index, hormone levels and polycystic ovaries at age 15 years for oligo-amenorrhoea at age 18 years. <i>Human Reproduction, 19(2), 383-392.</i> doi:10.1093/humrep/deh079</p> <p>Level II</p> <p>Quality: Good</p> | <p>Full maturation of the hypothalamus & endocrine system for the female fertility cycle can take up to 5 years. It is physiologically normal to have variation in the adolescent fertility cycle within this time period. It has been noted that up to 50% of adolescents that experience oligomenorrhea continue to have oligomenorrhea at follow up in 8 years. It is hypothesized that there are indicators present during the perimenarcheal adolescent period to indicate the presence of PCOS & a better indicator of adulthood ovulatory dysfunction.</p> | <p>Of the 2705 survey's handed out, 2,248 girls from age 14-17 years were recruited and used in the study. Geographical region was a closed cohort in a public high school south of Amsterdam.</p> | <p>Case control nested in a closed cohort. Observational with survey handouts.</p> | <p>Adolescent girls filled out a survey on the length and pattern of their menstrual cycles. The groups were divided into 2 groups, those with a cycle length of 22-34 days and 35-41 days. Oligomenorrhea was chosen as the primary outcome measured as it is also the primary reason for adult infertility. Blood samples were taken at 2 different dates and times to measure hormone levels, insulin, blood sugar and a pelvic ultrasound between the first and tenth day of their cycle.</p> | <p>The menstruation pattern within the first years of menarche are a better indicator of adult ovulatory dysfunction or adult infertility than serum LH and androgen levels. Those with oligomenorrhea at age 15 have a high predictive rate of having oligomenorrhea also at age 18 or older. A BMI above the median of peers is also a predictor of oligomenorrhea during adolescence and into adulthood.</p> | <p>It was not found that ovulatory dysfunction was influenced either positively or negatively with oral contraceptives (OC). Ovulatory dysfunction found before OC use were still present after discontinuation of OC. Weight loss for adolescents is the best treatment method for obesity and PCOS in adolescents. Metformin, although helpful in insulin resistance, should be prescribed with caution in adolescents that do not desire fertility.</p> |

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| <p>Gibbs, J. C., Williams, N. I., Scheid, J. L., Toombs, R. J., & De Souza, M. J. (2011). The association of a high drive for thinness with energy deficiency and severe menstrual disturbances: Confirmation in a large population of exercising women. <i>International Journal Of Sport Nutrition & Exercise Metabolism</i>, 21(4), 280-290.</p> <p>Level II</p> <p>Quality: Good</p> | <p>It was hypothesized that there is a strong association in women with a high drive for thinness (DT) and clinical eating disorder to have increased disturbances of the menstrual cycle including amenorrhea and oligomenorrhea as opposed to women with a normal drive for thinness.</p> | <p>99 women volunteers ages 18-35 without any chronic illness and in good health as determined by a medical examination. Women had to be free from hormonal contraceptive within the previous 6 months and no evidence of an eating disorder. All the women had 3 months of stable menstrual cycles preceding the study and participate in 2 or more hours of purposeful exercise per week.</p> | <p>Cross sectional study done comparing exercising women with high drive for thinness and normal drive for thinness</p> | <p>Volunteers kept logs of their purposeful exercise for at least two separate 7-day intervals during the study. A Chi-square analyses was used to compare the distribution of menstrual disturbances between the two groups. Resting energy expenditure (REE) were measured in both groups and compared. DT score was obtained from the EDI-2 (Garner & Olmsted, 1991), which is a subscale of the EDI-2 used to predict the presence of a subclinical (if severely high, clinical) variant of disordered eating that is often observed in exercising women. Normal DT was determined with a score of less than 7, 7 or greater was determined as a high DT.</p> | <p>Measures of REE and adjusted REE were suppressed in exercising women with high DT vs. normal DT, respectively. A greater prevalence of severe menstrual disturbances was observed in the high-DT group</p> | <p>This study confirms the association that women with a high DT score have a higher incidence of severe menstrual disturbances compared to women with a normal DT. Women with disordered eating behavior also have similar patterns menstrual disturbances as those with high DT.</p> |

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| <p>Blackwell, L. F., Vigil, P., Cooke, D. G., d'Arcangues, C., & Brown, J. B. (2013). Monitoring of ovarian activity by daily measurement of urinary excretion rates of oestrone glucuronide and pregnanediol glucuronide using the Ovarian Monitor, Part III: Variability of normal menstrual cycle profiles. <i>Human Reproduction</i>, 28(12), 3306-3315. doi:humrep/det389</p> <p>Level II</p> <p>Quality: High</p> | <p>The purpose of this study was to establish hormonal definition of the fertile days of the cycle by monitoring at home for the purposes of Natural Family Planning. They hypothesized that there are variables and characteristics within the normal menstrual cycle. Profiled by excretion rates for the urinary metabolites oestrone glucuronide (E1G) and pregnanediol glucuronide (PdG).</p> | <p>This was a 3-year study that involved 62 women from a multi-center population from 3 different countries, New Zealand, Australia and Chile.</p> | <p>Prospective cohort study</p> | <p>Women took daily measurements of oestrone glucuronide (E1G) and pregnanediol glucuronide (PdG) excretion in their urine. Urine samples were taken at a time that was convenient for them.</p> | <p>There is a continuum of menstrual cycle profiles that differ from standard textbook profiles, but which can be understood simply in terms of growth, atresia and ovulation of ovarian follicles. Periods of fertility and subfertility were recognized clearly by the women as their cycle unfolded daily from their home hormone measurements without recourse to any previous cycle history.</p> | <p>Excretion of urinary E1G and PdG rates is a valuable tool for women in assessing and understanding their personal fertility as well as their ability to define their window of fertility. accurately. The E1G and PdG results have considerable relevance for natural family planning application in avoiding or achieving pregnancy.</p> |

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| <p>Laughlin-Tommaso, S. K., Borah, B. J., & Stewart, E. A. (2015). Effect of menses on standardized assessment of sexual dysfunction among women with uterine fibroids: a cohort study. <i>Fertility and Sterility, 104</i>(2), 435-439. doi:10.1016/j.fertnstert.2015.04.029</p> <p>Level I</p> <p>Quality: High</p> | <p>The purpose was to determine if there was a perceived decrease in sexual function related to symptomatic uterine fibroids. It was hypothesized that women with symptomatic uterine fibroids, who have heavy and prolonged periods, would likely score lower in the Female Sexual Function Index (FSFI) as well have higher pain scores during menses.</p> | <p>33 premenopausal women at the Mayo Clinic (Rochester) and Duke University who were enrolled in the “Fibroid Interventions: Reducing Symptoms Today and Tomorrow” study who had symptomatic uterine fibroids</p> | <p>Prospective cohort study of an existing RCT study</p> | <p>The FSFI was administered during and between menstrual periods in women with symptomatic uterine fibroids. The FSFI is a 19-piece questionnaire which screens sexual function in 6 categories: desire, arousal, lubrication, orgasm, satisfaction, and pain. The cut-off score of 26.55 was used to differentiate women with sexual dysfunction. Those with a score of less than 26.55 were placed in the category of sexual dysfunction.</p> | <p>Sexual function and perception of sexual function varies within the menstrual cycle of individual women. It was difficult to score women who had no sexual intercourse as that could have a multi-factorial cause relating to symptoms present due to fibroids, interest or partner not being available.</p> | <p>Discordances in scores taken during and between menses increases the knowledge of sexual function in both affected and unaffected women during their menstrual cycle. The use of discordance scores as well as mean scores is a valuable tool to evaluate the effect of the menstrual cycles on sexual function.</p> |

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| <p>Castillo-Martínez, L., López-Alvarenga, J. C., Villa, A. R., & González-Barranco, J. (2003). Menstrual cycle length disorders in 18- to 40-y-old obese women. <i>Nutrition, 19</i>(4), 317-320. doi:10.1016/s0899-9007(02)00998-x</p> <p>Level II</p> <p>Quality: High</p> | <p>The purpose of the study was to measure the relationship between the length of menstrual cycles in women with obesity, the severity of menstrual cycle disorders and the degree of obesity.</p> | <p>120 women age 18-40 were recruited from an outpatient obesity clinic. Women with PCOS were excluded as they already have a higher degree of menstrual disturbances.</p> | <p>Cross-sectional observational study</p> | <p>Obesity was classified into five categories that were relative to their weight:</p> <ol style="list-style-type: none"> 1. Waist-to-hip ratio was measured 2. comorbidities were assessed in each patient <p>Patients were asked to record their menstrual cycle characteristics for 3 months. A logistic regression analysis was performed, using age and type 2 diabetes as confounding variables. Measurements of fasting plasma glucose, insulin, total cholesterol, triacylglycerol, high-density lipoprotein cholesterol, and low-density lipoprotein cholesterol were taken.</p> | <p>The main finding of this study was that higher the grade of obesity the greater association to menstrual cycle irregularities in women without PCOS. Higher degree of obesity had a higher probability of menstrual cycle disturbances such as amenorrhea and oligomenorrhea. Obesity alone appears to be an independent risk factor for some hormonal abnormalities.</p> | <p>The results suggest that adipose mass is not the best indicator of menstrual disturbances but that adipose distribution and obesity grade are important factors. The increasing risk for menstrual length disorders is associated with increasing obesity. This adds to the knowledge about the association between weight and menstrual disorders in patients diagnosed with morbid obesity</p> |

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| <p>Labyak, S., Lava, S., Turek, F., & Zee, P. (2002). Effects Of shiftwork on sleep and menstrual function in nurses. <i>Health Care for Women International</i>,23(6-7), 703-714. doi:10.1080/07399330290107449</p> <p>Level III</p> <p>Quality: Good</p> | <p>The purpose of this study was to explore the effect of sleep and shiftwork on the menstrual cycle. The researchers hypothesized that changes in the menstrual function of female shiftworkers were associated with changes in the 24-hour sleep/wake circadian rhythm.</p> | <p>1,199 nurses were recruited from a large Midwestern metropolitan hospital and included nurses less than 40 years of age who met the following criteria: 1) reported regular menstrual periods during most of their life 2) did not report diagnosis of menstrual dysfunction 3) had any type of reproductive surgery such as tubal ligation or uterine fibroids.</p> | <p>Descriptive survey study</p> | <p>Nurses in the study were asked to complete the “Nursing Shiftwork Questionnaire”. The questionnaire was a three-part survey which consisted of questions regarding: 1) reproductive history 2) sleep history 3) demographic Nurses were asked to report information about changes in menstrual cycle regularity, menstrual flow, pain and/or other symptoms associated with menstruation. They were also asked to report the duration of the menstrual cycle when working the day shift, evening shift, or night shift.</p> | <p>Nurses who worked shift rotations reported longer menstrual cycles, more symptoms during menstruation, and more menstrual disturbances requiring medical intervention than women who did not work rotating shifts. Fifty-three percent of nurses in the study reported menstrual cycle disruptions while working shiftwork. The 3 nurses who were experiencing infertility were working shiftwork at the time. Of the 9 women who had a miscarriage during the study, 5 of them were working shiftwork at the time. The most commonly cited effect was an increase in blood flow during menstruation.</p> | <p>The nurses reporting changes in menstrual function noted significantly more sleep disturbances and difficulty concentrating at work. There is also a higher incidence of other physiological symptoms of shiftwork which includes intolerance to shiftwork. These nurses have significantly longer sleep latencies when working shiftwork than nurses who did not report menstrual changes. Although it is not clear if sleep disturbance causes menstrual cycle disturbances or vice versa, but the relationship between the two is clear.</p> |

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| <p>Gonzalez, S. (2017). The Menstrual Cycle as a Vital Sign: The use of Naprotechnology® in the evaluation and management of abnormal vaginal bleeding and PCOS in the adolescent. <i>Issues in Law and Medicine</i>,32(2), 277-286.</p> <p>Level III</p> <p>Quality: Low</p> | <p>The purpose of this study was to identify why and how the menstrual cycle should be used as a biomarker for general female health. By charting the menstrual cycle, it can create a visual picture of pathophysiologic conditions that may be present.</p> | <p>Adolescent females</p> | <p>Author manuscript</p> | <p>Cycle length was between 29-133 days with a mean length of 45 days, post peak phase was measured at between 11-25 days with a mucus cycle score of 0-10.7. Abnormal uterine bleeding (AUB) was defined as >80ml per menses cycle or changing pads/tampons every 1-2 hours.</p> | <p>Reducing insulin resistance with weight loss improves the symptoms of PCOS. A weight loss of 10% is often enough to restore normality to the menstrual cycle. When lifestyle changes do not result in weight loss, metformin may be prescribed for insulin resistance.</p> | <p>Acute management involves counseling about weight loss, nutrition, lifestyle changes and prevention of diabetes. Chronic management includes assessment of and counseling for cardiovascular health, hypertension and dyslipidemia. Management of AUB includes hemodynamic stability, correct anemia, resume regular cycles and prevent recurrence and long term consequences of anovulation.</p> |

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| <p>Sohda, S., Suzuki, K., & Igari, I. (2017). Relationship between the menstrual cycle and timing of ovulation revealed by new protocols: Analysis of data from a self-tracking health app. <i>Journal of Medical Internet Research, 19</i>(11). doi:10.2196/jmir.7468</p> <p>Level I</p> <p>Quality: High</p> | <p>The purpose was to obtain data from the self-tracking phone app users to improve the accuracy of predicting the next ovulation date.</p> | <p>7043 Japanese women with reliable menstrual and ovulation records who were using the Luna Luna self-tracking menstrual cycle app. Luna Luna is a total health care service for female mobile phone users in Japan</p> | <p>RCT</p> | <p>The data from the 7043 women was analyzed with the relationship between the menstrual cycle length, follicular length and luteal phase length along with the timing of ovulation and compared it to the existing calendar-based methods.</p> | <p>The correlation between the length of the menstrual cycle and length of the follicular phase was stronger than the correlation between the length of the menstrual cycle and the length of the luteal phase. A strong positive correlation was seen in the mean length of past cycles and the length of the follicular phase. The method “Optimized” outperformed the “Ogino” method for predicting next ovulation, which also outperformed the method of current last middle day of the cycle.</p> | <p>Accuracy of the projected next ovulation date improved with increased number of cycles each user had tracked. This study also demonstrated how the present calendar methods of predicting the ovulation date as a whole were improved with more accurate grouping of women, which is then greatly supported statistically with a massive number of cycles.</p> |

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| <p>Fehring, R. J., Schneider, M., & Raviele, K. (2006). Variability in the Phases of the Menstrual Cycle. <i>Journal of Obstetric, Gynecologic & Neonatal Nursing</i>, 35(3), 376-384. doi:10.1111/j.1552-6909.2006.00051.x</p> <p>Level II</p> <p>Quality: Good</p> | <p>To determine the variability in the phases of the menstrual cycle among healthy women who are regularly cycling.</p> | <p>141 healthy women who monitored between 3 and 13 cycles with a total of 1,060 usable cycles</p> | <p>Prospective descriptive study</p> | <p>The length of the cycle, the follicular and luteal phases were monitored and the peak day of ovulation monitored by urine measurements of an electronic LH hormone fertility monitor and serum levels of LH.</p> | <p>Among regularly cycling women, there is a great deal of normal variation within the phases of the menstrual cycle. The follicular phase has the most variability; the luteal phase is more stable with a variation of only 6 days. The most variation occurs in the beginning years of menstruation and the last few years of menstruation, the return of fertility after childbirth/breastfeeding and after discontinuation of hormonal birth control. The fertile 6-day phase is confirmed but only 30% of women have their fertile phase between day 10 and 17 of their cycle.</p> | <p>Lifestyle behaviors such as obesity, smoking, excessive exercise/dieting and stress affected cycle variability and ovulation. That although cycle length had great variability (7-14 days) from woman to woman and from cycle to cycle in the same women. The luteal phase is the most stable portion of the cycle with a range of only 6 days. The menstrual cycle is a sign of health and disease in women.</p> |

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| <p>Menstruation in Girls and Adolescents: Using the Menstrual Cycle as a Vital Sign. (2016). <i>Pediatrics</i>, 137(3). doi:10.1542/peds.2015-4480</p> <p>Level IV</p> <p>Quality: High</p> | <p>The importance of using the menstrual cycle in adolescent girls and the value of charting their cycle for assessment and diagnosis.</p> | <p>Adolescent girls who are menstruating.</p> | <p>Committee Opinion</p> | <p>Uterine bleeding of >80ml per cycle is considered excessive. The range of cycle length between 21-45 days is considered normal. Cycle lengths under 21 days and over 45 days were considered abnormal.</p> | <p>Abnormal uterine bleeding (AUB) may be caused by ovulatory dysfunction. Bleeding ranges from amenorrhea to irregular heavy menstrual bleeding. Ovulatory dysfunction in the first years of menstruation a physiologic normality the first few years of menstruation but it can be associated with endocrinopathies due to hypothalamic-pituitary-ovarian axis disturbances.</p> | <p>Clinicians should include anticipatory guidance about puberty and menstruation into their practice when assessing girls starting at 7 to 8 years old. This not only establishes a dialogue between the caretaker, patient and provider but educates the caretaker and patient on the normal processes of menstruation. The menstrual cycle is considered a vital sign of health and disease in adolescent girls and charting the cycle establishes a visual for accurate assessment.</p> |