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William F. Connell School of Nursing

FERTILITY-AWARENESS PRACTICES AMONG WOMEN SEEKING
PREGNANCY

a dissertation

by

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Fertility-Awareness Practices Among Women Seeking Pregnancy

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Abstract

Background: Infertility is a source of significant distress to women, their partners, and their families. If women are unable to identify the time in their cycle when conception is most likely (the fertile window) then they may be referred to fertility services unnecessarily, which incur costly, invasive, and risky interventions. Little is known about women's experiences trying to conceive using fertility-awareness based methods. **Objective:** The purpose of this dissertation research is to examine fertility-awareness based method (FABMs) use among women seeking pregnancy, specifically as it relates to fertility knowledge, method frequency, predictors of use, and duration of pregnancy attempt. **Methods:** This manuscript-style dissertation will utilize multiple data sources and methods to address four major goals. First, an integrative review of peer-reviewed publications will synthesize the literature regarding fertility knowledge and fertility- awareness practices (Aim 1). Second, a secondary analysis of data from the CDC's National Survey of Family Growth (2015-2017) will be used to identify factors that influence women's decision to use FABMs (Aim 2). Third, an analysis of data from the Nurses' Health Study 3 will be used to evaluate whether duration of current pregnancy attempt is associated with FABM(s) use (Aim 3). Lastly, a case study will be presented using the qualitative methodology of narrative interview to describe women's experiences using FABMs to achieve pregnancy (Aim 4). **Conclusions:** Collectively, this work advances the science by providing researchers and clinicians with the knowledge to support women in their journey to natural, spontaneous conception. *MeSH Keywords:* fertility-awareness-based methods, pre-conception, pregnancy

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Introduction to the dissertation

Introduction

Infertility, as defined by the American Society for Reproductive Medicine, is the inability to conceive after 12 months of unprotected intercourse and is cited as one of the most common diseases for people between the ages of 20-45. Assisted Reproductive Technology (ART) refers to treatments and procedures that aim to achieve pregnancy in which both eggs and embryos are handled. Women and couples may be referred to ART because of difficulty conceiving spontaneously. According to the Centers for Disease Control (CDC), the use of ART has doubled over the past decade, yet only 1.7% of all infants in the United States are born each year because of successful ART conception (CDC, 2021). Research has shown that most women poorly recognize the fertile period of the menstrual cycle. If women are unable to identify the time in their cycle when conception is most likely (the fertile window) then they may be referred to ART unnecessarily. Superfluous referral can lead to costly, invasive, and risky interventions. The literature has identified barriers to providing fertility education to women in clinical practice, including resources, provider knowledge, and medical dominance. It is problematic that women may be referred to ART before efficacious, natural, and simpler interventions are explored. Women's inaccurate identification of the fertile window (fertility- awareness) can contribute to unexplained infertility (Hampton et al., 2013), and fertility-awareness based methods (FABMs) should be explored as a potential intervention. While a lack of fertility-awareness can be associated with both unplanned pregnancy and infertility, the focus of this dissertation is exploration of fertility-awareness based methods for the purpose of achieving pregnancy. The holistic, informational, and integrative nature of fertility-awareness fits well within professional nursing practice, and it is essential that research focuses on exploring women's experiences with fertility-awareness based methods.

Significance

Infertility. Infertility, an important health issue nationally and globally, is defined as failure to establish a pregnancy after 12 months of regular, unprotected sexual intercourse. Data suggests that at least 50 million couples globally experience infertility (Mascarenhas et al., 2012). Fertility problems within the United States affect substantial numbers of women. Using data from the National Survey of Family Growth (NSFG) 2015-2017, the Centers for Disease Control and Prevention (CDC) reported that 12.1% of women aged 15-44 years in in the United States have difficulty getting pregnant or carrying a pregnancy to term. Consequently, the CDC estimated 7.3 million women in the United States aged 15-44 have used infertility services (CDC, 2021). There is a gap in knowledge regarding the fertility tracking behaviors of women prior to seeking infertility services. It is important to explore current practice standards for referring women to ART.

Practice Guidelines. The American College of Obstetricians and Gynecologists (ACOG) and the American Society for Reproductive Medicine (ASRM) have established national recommendations for health care providers who care for women, including offering infertility evaluation for heterosexual couples that are infertile or high risk for infertility. Components of this evaluation include: 1) assessment for signs of ovulation (e.g. positive ovulation tests, and patient reported cervical mucus changes and/or biphasic basal body temperatures), 2) assessment of tubal patency, and 3) semen analysis. Unexplained infertility is diagnosed when a woman or couple have evidence of ovulation, tubal patency, and a normal semen analysis (ACOG, 2019). However, evidence of ovulation is limited by patient self-report. If the patient lacks knowledge related to signs of ovulation and ovulation tracking methods, she may misidentify her fertile window, and be engaging in intercourse at the incorrect time (Hampton et al., 2013). Current

standard of practice for a referral to an infertility specialist or Reproductive Endocrinology is based on age and duration in months of trying to conceive (ACOG, 2019), plus any data collected in initial infertility evaluations if they were performed. However, there is not a standard for how health care providers review a woman's ovulation tracking methods to establish evidence of ovulation before referral to Assisted Reproductive Technology (ART). Better education of women in regards to their cycle and fertile window could reduce the need for ART and increase spontaneous conception.

Assisted Reproductive Technology. Assisted Reproductive Technology (ART) treatments to assist women in achieving pregnancy are not without risk. ART pregnancies are associated with greater risk of multiple gestations, miscarriages, and ectopic pregnancies. Outcomes such as the aforementioned not only increase morbidity and mortality for mothers and newborns, but also length of admissions, further increasing health care costs (Bromer et al., 2011). According to a 2015 report from the American Society for Reproductive Medicine, the median price of a cycle of in vitro fertilization in the United States, including medications, was $19,200 (estimated at $20,909.08 in fiscal year 2020)(Daar et al., 2015; Wu et al., 2014) According to the CDC's 2017 Fertility Clinic Success Rate Report, that although the use of ART has doubled over the past decade, only 1.7% of infants born every year in the United States are conceived using ART (CDC, 2019). Additionally, women may not want to pursue ART due to personal, cultural, religious, or financial reasons (Hampton et al., 2013). Value systems may influence reproductive decision making, but each woman is unique and it is important to assess which values a woman may hold in keeping with the official teachings of her religion or cultural norms (Srikanthan & Reid, 2008). Therefore, it is essential that nurses, nurse practitioners, and nurse midwives are well equipped to provide evidence-based fertility- awareness based method (FABM) education

(whether that be cervical mucus, basal body temperature, urinary luteinizing hormone, etc.) to women when first reporting difficulty conceiving. Education regarding the menstrual cycle is essential to provide as well as an assessment of women's baseline fertility knowledge.

Fertility Knowledge. For women who are trying to conceive, it is critical to assess women's knowledge regarding fertility, specifically the accurate detection of the fertile window in each cycle. Righarts et al., (2017) noted that only 23.3% of women in their study had monitored ovulation in order to conceive. Yet, 39.9% of women who had monitored to conceive were not able to recognize when the optimal time for conception occurs and only 16.8% of self-monitoring women had sufficient natural fertility knowledge. Therefore, knowledge regarding fertility must be used in concert with fertility monitoring or tracking to be successful. It is important to compare Righarts et al., (2017) findings to other studies regarding fertility knowledge among women seeking conception. Additionally, it is essential to identify sources of fertility education and what women are utilizing to achieve pregnancy.

Barriers. Hampton et al., 2015 identified that (1) resources (time, materials, and reimbursement), (2) provider knowledge and skill, (3) medical dominance were barriers to providing fertility- awareness education in practice. Although the study was done in Australia, similar barriers may face providers in the United States. Hampton et al., (2015) found that short appointment scheduled-blocks made it difficult to provide detailed instruction about fertility and patients did not seek to make appointments solely to discuss fertility options but rather sought out the information in the context of other consultations when no time was available. It was identified that the best time for the discussion would be at a preconception counseling visit but that these were rarely attended and when attended, other important topics needed to be fit in. Nurses, physicians, and other health care providers often have little knowledge about the cycle

and about methods of natural family planning. Fehring (2004) identified that little or no information on FABMs are provided in nursing or medical schools. Because few health care professionals have in-depth knowledge, appreciation, and understanding of natural family planning, they do not readily prescribe these methods for their patients. Lastly, systems are well established for referring infertile people to ART clinics and direct marketing by ART services encourage early referrals.

Fertility-Awareness Based Methods/Natural Family Planning. Several evidenced-based fertility-awareness based methods (FABMs) allow women to predict ovulation and estimate peak fertility. Successful use of these fertility-awareness based methods depends on competent instruction and follow-up, correct and consistent charting, and on the woman's adherence to the principles of their chosen method. Commonly used FABMs include monitoring the menstrual cycle, cervical mucus, basal body temperature, and detection of urinary or salivary luteinizing hormone. Each FABM has advantages and limitations, and fertility-awareness education can assist with determining the approach best aligned with the woman or couple's personal goals. Additionally, more than 100 million women worldwide use menstrual cycle tracking apps. However, most app reviews and ratings refer to user characteristics rather than the underlying science supporting the predictions made by the app. The explosion in apps has significantly expanded the awareness of natural methods, but whether this translates into increased use of fertility- awareness based methods is still in question (Manhart et al., 2018). Duane et al., 2016 found in their systematic review of 95 charting apps that only 6 apps scored high on both authority (well documented FABMs with evidence) and accuracy (complete agreement with the fertile window). Results of that analysis show that the majority of apps are not based in evidence. For women who are using apps not based in evidence, and which may wrongly predict a fertile

window, this may further delay time to pregnancy. For women trying to conceive, it is important to assess what women are choosing as their method of fertility- awareness. Especially since the use of an evidence-based fertility- awareness based method (FABM) could be an initial intervention for decreasing infertility.

Literature

Pedro et al., 2018 conducted a systematic review (n=71) on fertility-awareness and its associated factors with the purpose to identify what people know about fertility. Because of the heterogeneity and diversity of the samples, the differences in sample sizes, and the broad eligibility criteria, the review was unable to summarize the relationships related to fertility-awareness knowledge among different populations. The scant differential findings did not paint a clear picture of who is in need of fertility-awareness and during what phase within reproductive life fertility knowledge should be disseminated as well as how fertility education should be disseminated (Pedro et. al, 2018). Therefore it is important to synthesize the literature regarding fertility knowledge and women's attitudes towards fertility-awareness methods specifically among women who are seeking pregnancy. Manders et al., (2015) conducted a Cochrane Review to review the evidence about the effect of timed intercourse versus spontaneous intercourse in couples trying to conceive. The reviewed examined five randomized controlled trials that compared timed intercourse versus intercourse without ovulation prediction. The authors found that timed intercourse may improve pregnancy rates compared to intercourse without ovulation prediction, but there was insufficient data to draw conclusions on the effectiveness of timed intercourse for the outcomes of live birth, adverse events, and clinical pregnancy. Although the purpose of the review was to assess the benefits and risks of timed intercourse on pregnancy outcomes, the overall quality of the evidence ranged from low to very low for all outcomes,

which emphasizes the need for better conducted research in this area. Much of the existing literature has focused primarily on efficacy for the specific models of FABM, with a heavy concentration in the effectiveness of FABMs to avoid pregnancy. There is a gap in the literature regarding the experiences of the women using FABMs to achieve pregnancy.

Theoretical Framework

Warren B. Miller created the Traits- Desires-Intentions-Behavior (T-D-I-B) theoretical framework in 1994 while he was the director of the Transnational Family Research Institute, as a way to conceptualize the social and behavioral motivations one has for childbearing. "The framework is based on a four-step sequence: formation of traits, the activation of traits into desires, the translation of desires into intentions, and the implementation of intentions in the form of behavior" (Miller, 1994, p.225). Miller recognized that there were existing theories to explain why people chose to become parents, and that these approaches incorporated different constructs within different frameworks (Miller, 2011a). His aim was to create one framework based on the construct of motivation and that other constructs, such as attitudes, values, norms, desires, and intentions, could be integrated into it. The T-D-I-B theoretical framework has been used in research to examine differences in family planning choices among specific groups, as it acknowledges that there are important factors that may affect behavior. The T-D-I-B framework has been applied to research investigating pregnancy-related decision-making among HIV-positive populations and among childless men and women. (Wagner et al., 2014; Amutah et al., 2016; Mynarska & Rytel, 2018; Finocchario-Kessler et al., 2010). The T-D-I-B sequence is as follows: 1) the woman develops positive and negative childbearing motivational *traits,* 2) positive *traits* can lead to *desire* to have children, 3) she *intends* to have children, 4) she engages in *behavior* which may result in pregnancy (Miller, 2011b). Traits are the inclinations that people

have to react in specific ways under certain conditions. "Trait formation is itself a long and complicated process in which life experiences act in conjunction with biological characteristics of the individual to form learned dispositions" (Miller, 1994, p. 230). Examples of motivational traits, both positive and negative, include age, gender- role orientation, family composition, marital support, religion, income, and educational level. These traits may play a role in the activation of desire. Desires are psychological states that represent what someone wishes for or wants; desires represent feelings about possible goals or objectives. Desire includes child-number, child-timing, and childbearing desires. Desires may or may not lead to intention because one must consider the desire and intentions of the partner or situational considerations, like unemployment of the breadwinner, lack of adequate financial resources, or crowded living situation. Intentions are the psychological stats that represent what someone actually plans to do. Intentions are based on desires but take into consideration what can actually be achieved. Behavior, therefore, can be to avoid or achieve pregnancy based on the couple's intentions. The T-D-I-B model primarily focuses on proceptive (achieve) behavior, rather than contraceptive (avoid) behavior, and acknowledges that there are important factors that may affect proceptive behavior. Factors include occurrence of major events, presence of some barrier (infertility), and social support or lack of support. Because the T-D-I-B model examines predictors of reproductive decision making and behavior, it is an ideal theoretical framework to guide research on fertility-awareness based method utilization among women seeking pregnancy (Wagner et al., 2014). The theory has been expanded in more recent years to include the couple as a dyad, but because the proposed dissertation research is considering only the woman's behavior of fertility monitoring, the original T-D-I-B framework is applicable (Miller et al., 2004). Figure 1 (pictured

below) was taken from Miller's "Differences between fertility desires and intentions:

implications for theory, research, and policy" (2011) manuscript.

Figure 1:
An expansion of the T-D-I-B model to show the interactions of two types of traits, three types of desires and three types of intentions in their effect on two fertility behaviours and the probability of any subsequent fertility events
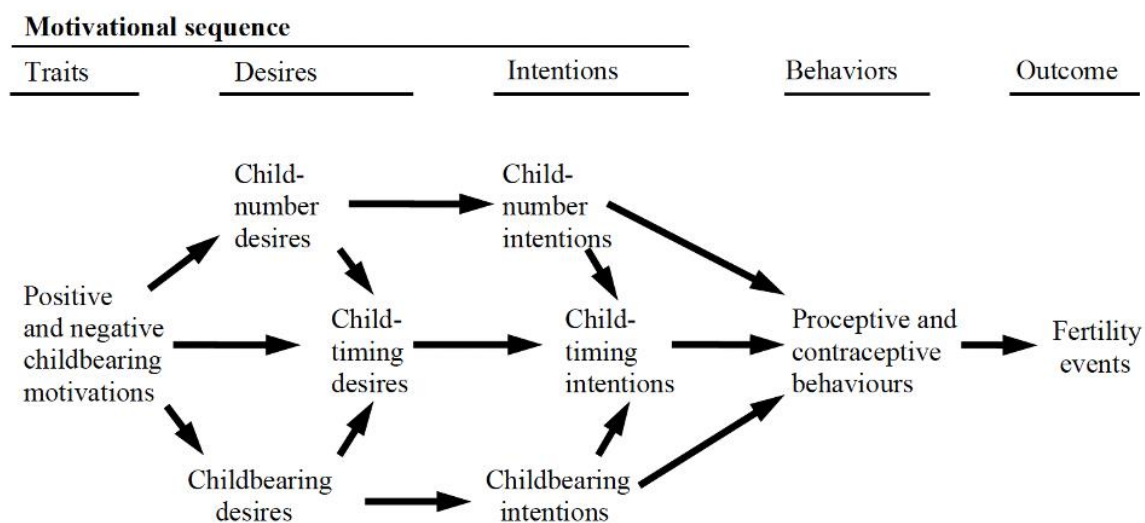
Note: Adapted from Miller (1994)

The proceptive behavior of interest is the use of a fertility-awareness based method(s). Using the

T-D-I-B framework, proposed manuscript #1 in this dissertation aims to synthesize the literature

regarding the *trait* of fertility knowledge as well as the literature on the *behavior* of fertility-

awareness use among women seeking pregnancy. Proposed manuscript #2 will use the National

Survey of Family Growth (NSFG) dataset to explore which *traits* may be predictors for

utilization of the FABMs *(behavior)* included in the dataset among women who had sought

advice from a provider regarding how to achieve pregnancy. The T-D-I-B framework has been

used to guide research that has used data from the NSFG, which collects data on respondents'

motivations towards childbearing, contraception history, infertility, and other demographic traits

(Miller et al., 2016). Proposed manuscript #3 will use the T-D-I-B theoretical framework to explore current duration of pregnancy attempt in the Nurses' Health Study 3, as the duration of *intention* could potential influence type and number of FABM(s) chosen *(behavior).* Proposed manuscript #4 will not use a theoretical framework as it will be a case study using a qualitative narrative interviewing approach. As such, using the narrative interviewing method permits use of different women's stories, which is the optimal way to understand the intricacy in women's experiences and perceptions. The narrative approach allows the development of an overarching timeline of decision-making regarding fertility and FABM utilization and gain insights, not only into the process of fertility tracking and use of a variety of FABMs, but also into the feelings related to the process. Therefore, it would be inappropriate to use the T-D-I-B framework for this methodological approach, although findings may contribute to our theoretical understanding.

Purpose and Aims

 Women's inaccurate identification of the fertile window (fertility-awareness) can contribute to unexplained infertility (Hampton et al., 2013). It is essential that accurate information and instruction regarding identification of the fertile window be provided to women, as this may improve conception rates, subsequently reducing unnecessary medical intervention and costs (Stanford et al., 2002; Manders et al., (2015). Nurses have an in-depth understanding regarding the meaning of the human person, human relationships, human sexuality, and the transmission of life, making nurses the preferred practitioners to delivering fertility- awareness education (Fehring, 2004). First it is necessary to explore women's fertility knowledge and their experiences with fertility-awareness based methods (FABMs) so that education in practice is

successful. Therefore, *the overall goal of this dissertation is to examine fertility knowledge and fertility- awareness practices among women seeking pregnancy.*

The following are specific aims the dissertation will address (see Table 1 for details on which chapter will address each aim):

Aim 1: Synthesize the literature regarding fertility knowledge and fertility- awareness practices among women who seek pregnancy. *Manuscript 1*

Aim 2: Explore the factors that influence women's decision to use FABMs. *Manuscript 2*

Aim 3: Evaluate whether duration of current pregnancy attempt is associated with fertility- awareness based method(s) use. *Manuscript 3*

Aim 4: Describe women's experience using FABMs to achieve pregnancy. *Manuscript 4*

Table 1. Chapters and Aims			
Overall Purpose: Examine fertility knowledge and fertility awareness practices among women seeking pregnancy.			
Research Question	**Aims**	**Manuscript**	**Chapter**
How knowledgeable are women who seek pregnancy about fertility? What are women's attitudes towards fertility awareness education and methods?	Aim 1: Synthesize the literature regarding fertility knowledge and fertility awareness practices among women who seek pregnancy	Manuscript 1: Perez Capotosto, M. (2021). Integrative review of fertility knowledge and fertility- awareness practices among women trying to conceive. *Nursing for Women's Health, 25*(3), 198-205	2
What are the factors that influence FABM utilization?	Aim 2: Explore the factors that influence women's decision to use FABMs.	Manuscript 2: Perez Capotosto, M. & Jurgens, C. (2020). Exploring fertility-awareness practices among women seeking conception. *Nursing for Women's Health, 24* (6) 413-420	3

What is the relationship between duration of current pregnancy attempt and fertility-awareness based method used?	Aim 3: Evaluate whether duration of current pregnancy attempt is associated with fertility- awareness based method(s) use.	Manuscript 3: Perez Capotosto, M., Lee, C.S., Jurgens, C.Y., Charlton, B., & Chavarro, J. (2022). Factors that Contribute to Fertility-Awareness Based Method Use Among Women Trying to Conceive Target Journal: *The American Journal of Obstetrics & Gynecology (AJOG)*	4
What are women's experiences using a FABM to achieve pregnancy?	Aim 4: Describe women's experiences with a variety of FABMs to achieve pregnancy	Manuscript 4: Perez Capotosto, M., & Fu, M.R. (2021). A qualitative case study of women's experiences with fertility-awareness based methods to achieve pregnancy. *Target Journal: Journal of Midwifery and Women's Health*	5

Implications for nursing science

The goal of this body of work is to gain a greater understanding of the experiences of women seeking pregnancy regarding fertility-awareness based methods. It is necessary to explore that which may contribute to women's experiences with fertility- awareness methods for the purpose of conception. Nurses, nurse practitioners, and nurse midwives are the ideal practitioners to deliver FABM education, and results of this research can inform how to deliver it so that women are successful. Therefore, it is essential that nurses have an understanding of women's experiences with FABMs so that it can inform the delivery of effective fertility-awareness education.

Chapter II

Integrative Review of Fertility Knowledge and Fertility-

Awareness Practices Among Women Trying to Conceive

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Abstract

Objective: To synthesize the literature on fertility knowledge and fertility-awareness among women seeking pregnancy.

Data Sources: The search terms *Fertility awareness OR fertility knowledge AND women AND subfertile OR infertile OR seeking pregnancy OR trying to conceive OR pre-conception OR conception NOT contraception NOT birth control* were used via CINAHL, PubMed, and Web of Science. Primary research studies were considered in the search parameters.

Study Selection: Searches yielded 116 studies published between 1978 and 2020. After screening, 43 full text studies were assessed for eligibility, 35 of which were omitted as not relevant. Nine quantitative studies using cross-sectional designs met this review's inclusion criteria.

Data Extraction: Studies were reviewed for information on the relationship between fertility knowledge/fertility- awareness and pregnancy intention. Studies examining the results of fertility- awareness based method (FABM) efficacy, FABMs for contraception, and provider knowledge regarding FABM were omitted.

Data Synthesis: Analysis revealed low knowledge regarding the identification of the fertile window in the menstrual cycle to optimize pregnancy. There was moderate general knowledge on fertility (e.g., infertility definition, age of fertility decline, etc.). Use of a FABM and education regarding FABMs were infrequent, yet participants recognized that it would be beneficial to use and learn when trying to conceive.

Conclusion: Women seeking pregnancy have low to moderate fertility knowledge. More research is necessary on the relationship between fertility knowledge/fertility-awareness and unexplained infertility. Nurses, nurse practitioners, and nurse-midwives should provide

education on FABMs to women when they first report difficulty achieving pregnancy.
Clinicians' approaches toward FABM education for women and how to implement FABM
education into the preconception visit are important areas for future research.

Keywords: female, fertility, fertility-awareness, fertility knowledge, infertility, preconception,
pregnancy

Clinical Implications:

- Women have low knowledge of how to identify the fertile window, and moderate knowledge regarding the definition of infertility, age of fertility decline, male fertility factors, and perceived infertility risk factors.

- Women can use different methods to identify the fertile window; these include observation of cervical mucus, basal body temperature charting, calendar calculation, or detection of urinary luteinizing hormone.

- Nurses, nurse practitioners, and nurse-midwives should provide education on fertility-awareness based methods (FABMs) to women when discussing their childbearing intentions.

- Although this review is focused on women seeking conception, FABMs can be used to either achieve or avoid pregnancy.

Callouts:

Women desire fertility education and seek out information from a range of sources

For women who are trying to conceive, it is critical for clinicians to assess their general knowledge regarding fertility and fertility- awareness practices

By providing accurate information and instruction to women regarding how to track and identify the fertile window, conception rates could improve, leading to less need for intervention with assisted reproductive technology

Infertility is an important health concern on a national and global level. Infertility is defined as failure to establish a pregnancy after 12 months of regular, unprotected sexual intercourse. At least 50 million couples globally experience infertility (Mascarenhas et al., 2012). Within the United States fertility problems affect a substantial number of women. The Centers for Disease Control and Prevention (CDC) reports that approximately 13.1% of women ages 15 to 44 years report difficulty achieving pregnancy or carrying a pregnancy to term, with 12.7% using infertility services (CDC, 2019). The frequency with which women struggle with infertility warrants further investigation into overall fertility knowledge and fertility- awareness practices.

About Infertility

The American College of Obstetricians and Gynecologists (ACOG) and the American Society for Reproductive Medicine (ASRM) have established national recommendations for women's health care providers, including offering infertility evaluation for couples that are infertile or at high risk for infertility. Women's factors associated with higher risk for infertility include being age >35 years, smoking, underweight or overweight, history of sexually transmitted genital infections, alcohol consumption, and tubal surgery. Components of this evaluation are listed in Box 1.

Box 1. Components of Evaluation for Infertility Risk

1. Assessment for signs of ovulation (e.g., positive ovulation tests, and patient-reported cervical mucus changes and/or biphasic basal body temperatures)

2. Assessment of tubal patency

3. Semen analysis.

Unexplained infertility is diagnosed when a woman or couple have evidence of ovulation, tubal patency, and a normal semen analysis (ACOG, 2019). However, evidence of ovulation is limited by woman's self-report. If a woman lacks knowledge related to signs of ovulation and ovulation tracking methods, she might not able to correctly identify her fertile window. Consequently, this may result in her engaging in intercourse at the incorrect time in her cycle (Hampton et al., 2013). Current standard of practice for a referral to an infertility or reproductive endocrinology specialist is based on age and duration in months of trying to conceive (ACOG, 2019), plus any data collected in initial infertility evaluations (informed by a patient's fertility-awareness) if they were performed.

About Fertility Awareness

For women who are trying to conceive, it is critical for clinicians to assess their general knowledge regarding fertility and fertility-awareness practices to identify the fertile window. According to Zegers-Hochschild et al. (2017, p. 8), fertility- awareness is defined by the International Glossary on Infertility and Fertility Care as "the understanding of reproduction, fecundity, fecundability, and related individual risk factors (e.g., advanced age, sexual health factors such as sexually transmitted infections, and life style factors such as smoking, obesity) and non-individual risk factors (e.g., environmental and work place factors), including the awareness of societal and cultural factors affecting options to meet reproductive family planning, as well as family building needs." It is important to assess a woman's general knowledge regarding reproduction and risk factors for infertility in addition to how she understands her own fertility.

Fertility-awareness refers to a woman's identification of the fertile and infertile phases of her cycle. Fertility- awareness based methods (FABMs) are used to either achieve or avoid

pregnancy. FABM methods, including observations of cervical mucus, basal body temperature charting, calendar calculation, or detection of urinary luteinizing hormone and estradiol in ovulation predictor kits, can increase women's success in achieving contraception and reduce referral to costly specialized infertility care and treatments. Pedro et al. (2018) conducted a systematic review (*n*=71) on fertility-awareness and its associated factors with the purpose to identify what people know about fertility. Because of the heterogeneity and diversity of the samples, the differences in sample sizes, and the broad eligibility criteria, it was challenging for the researchers to summarize the findings. Therefore, the purpose of this integrative review is to synthesize the literature regarding fertility knowledge and women's attitudes toward FABMs specifically among women seeking pregnancy. The two research questions that guided this review were (a) *How knowledgeable are women who seek pregnancy about fertility?* and (b) *What are women's attitudes toward fertility- awareness education and methods?*

Methods

This integrative review was guided by Whittemore and Knafl's (2005) methodology, which includes five stages: problem identification, literature search, data evaluation, data analysis, and presentation (Whittemore & Knafl, 2005). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards and algorithm guided the tracking of the literature (Moher et al., 2009).

A literature search was conducted using CINAHL, PubMed, and Web of Science electronic databases. The following search terms were used to identity studies pertinent to the research question: *fertility- awareness* OR *fertility knowledge* AND *women* AND *subfertile* OR *infertile* OR *seeking pregnancy* OR *trying to conceive* OR *pre-conception* OR *conception* NOT *contraception* NOT *birth control*. The searches were conducted in February 2020 with the

assistance of a research librarian. After the manuscript was submitted for publication, an article meeting eligibility criteria was published, so an additional search was conducted in October 2020. Literature was assessed from across the globe although only studies published in English were retrieved. Consideration for review required that the publication be peer-reviewed, written in English, and published between 1978 and 2020. The earliest date of 1978 was set as this is the year the first baby born via conception with assisted reproductive technology in the world, and this historic time influenced the availability of infertility treatment and the perception of fertility-awareness utility, both in practice and research. Inclusion criteria consisted of research studies with a focus on fertility-awareness and fertility knowledge among women trying to conceive. Exclusion criteria consisted of anecdotal reports, commentaries, editorials, periodicals, review studies, studies under revision, and gray literature.

In total, these searches yielded 116 studies from the database searches; 92 after duplicates removed. Ninety-two abstracts were reviewed and 43 studies were chosen for full review. Reasons for exclusion included: studies assessing efficacy of FABM, evaluation of FABM websites or mobile apps, not written in English, women not seeking conception, not original research, and infertile and subfertile couples being excluded in the study. Of note, subfertility is a delay in conceiving, meaning that it takes the couple longer than average to achieve pregnancy (most pregnancies occur in the first six cycles of trying), whereas infertility is defined as someone who has been trying to conceive for at least 12 months without success. The terms are often used interchangeably but are not the same, much like infertility should not be confused with sterility, which is the physiological inability to produce offspring and is a permanent cause of infertility(Gnoth et al., 2005; Zegers-Hochschild et al. (2017).Nine studies were included in the final sample of this integrative review (see Supplemental Material for a diagram of study

selection). Data extraction of each study was performed using the matrix displayed in the Table found in Supplementary Material.

Critical appraisal of the literature used a modified appraisal tool derived from Hawker et al., 2002 as part of the inclusion/exclusion process. The Hawker et al. (2002) instrument was selected because it is "a method of systematically reviewing research conducted using different paradigms" (Hawker et al., 2002, p.1284). This instrument was modified by Naugler and DiCarlo (2018) to systematically review disparate data on safe sleep recommendations in preterm infants. Studies were given a total score ranging from 0-18 calculated by reviewing 9 categories: *abstract and title, introduction and aims, methods, sample, data analysis, ethics and bias, results, transferability and generalizability, and implications.* Each category received a score of either 0 (*poor*), 1 (*fair*), or 2 (*good*). The rating of *very poor* was excluded, as all the studies included components that would eliminate the possibility of a *very poor* rating. Studies that received a total score of less than 9, the midpoint of scoring, would have been excluded for incomplete reporting or poor methodology; none of the studies included in the final sample met this low threshold. The quality appraisal score (QA) for the included studies, as based on the Naugler and DiCarlo (2018) modification, is listed with each article description in the Table (see Supplementary Material).

Results

Nine studies with a cross-sectional design were included in the final sample of this integrative review. The studies were conducted in New Zealand, Australia, India, United States of America, and Japan. Two studies used data from the larger International Fertility Decision Making Study and included participants from 79 countries. The samples for all of these studies were composed of women attending infertility clinics or women with intention to conceive but

not yet receiving fertility services; sample sizes ranged from 80 to 8,355 women. Researchers either identified women's fertility knowledge related to the menstrual cycle and signs of ovulation or women's general knowledge regarding fertility and fertility risk factors (e.g., age of fertility decline, history of sexually transmitted infections, smoking, obesity, and use of assisted reproductive technology [ART] terminology) or both. Authors of retained studies also described women's attitudes toward the use of fertility- awareness monitoring methods for conception. Results are summarized in two categories: fertility knowledge, whether that be general fertility knowledge or knowledge related to the menstrual cycle, and attitudes toward fertility-awareness.

Fertility Knowledge

Across studies, women, regardless of sociocultural backgrounds, reported low knowledge related to their fertility. Authors of four studies, with participants in Australia, India, and New Zealand, specifically identified women's fertility knowledge regarding the menstrual cycle, ovulation, and the fertile window (Blake, Smith, Bargiacchi, France, & Gudex, 1997; Hampton, Mazza, & Newton, 2013; Mahey, et al., 2018; Righarts, Dickson, Parkin, & Gillett, 2017). All of the participants in these studies had scores indicating low knowledge regarding signs of fertility. Fifteen percent of women in the study by Blake et al. (1997) were knowledgeable about timing intercourse to align with their fertile time each month. Similarly, only 12.7% of women studied by Hampton et al. (2013) demonstrated accurate knowledge of either the mucus or temperature method to identify the fertile window. Likewise, only 14.9% of women in the study by Righarts et al. (2017) study correctly identified the timing of the fertile window. Additionally, Mahey et al. (2018) reported that 85% of women in their study failed to correctly identify the ovulatory period in the menstrual cycle. Knowledge regarding the fertile window and ovulation is essential

for timing conception. These authors identified that women had low knowledge scores regarding these essential signs of fertility.

Authors of five studies specifically examined women's general fertility knowledge. Two were international studies, one of which was based in Japan and used the Cardiff Fertility Knowledge Scale (CFKS), a 13-item questionnaire that assesses women's fertility knowledge (Bunting, Tsibulsky, & Boivin, 2013; Fulford, Bunting, Tsibulsky, & Boivin, 2013; Maeda, et al. 2015). The CFKS evaluates women's knowledge of the definition of infertility, age of fertility decline, male fertility factors (including male history of mumps because mumps can lead to oligospermia, azoospermia, and asthenospermia in males), and perceived infertility risk factors such as smoking, obesity, and a history of sexually transmitted infections. The statements in the CFKS do not assess a woman's knowledge of fertile signs within the menstrual cycle, such as cervical mucus or basal body temperature, as means to identify ovulation. The knowledge scores were modest, ranging from 51.9% (Fulford et al., 2013) to 56.9% (Bunting et al., 2013) using the CFKS instrument. Both Fulford et al. (2013) and Bunting et al. (2013) used findings from the International Fertility Decision-Making Study. Maeda et al. (2015) reported that 53.1% of women in the "trying to conceive" group were able to answer the statements of the CFKS correctly, which further supports moderate general fertility knowledge scores. Childress et al. (2015) reported that women also had modest baseline knowledge of reproductive anatomy, ART, and fertility factors, although these improved significantly after ART visits.

Results were similar in the study by Hoffman et al. (2020), who reported that, overall, women seeking pregnancy exhibited low to moderate fertility knowledge. The findings by Hoffman et al. (2020) suggest that when low-resource and high-resource groups were compared, women from low-resource communities had greater disparities in fertility knowledge compared

to women from high-resource clinical settings. Yet when the low-resource and high-resource groups were analyzed separately, education level was not a significant factor associated with fertility knowledge. Across these five studies, the literature confirms that women who are actively seeking pregnancy often have moderate general fertility knowledge, despite coming from diverse socio-cultural backgrounds.

Attitudes Toward Fertility- Awareness

Women's attitudes toward FABM ovulation tracking were examined in three studies. Blake et al. (1997) reported that only 13% of the women had previously attended a natural family planning (NFP) clinic despite the fact that 80% indicated they would be interested in attending a NFP clinic. Of the 13% of women who received NFP education, 80% had high fertility- awareness secondary to the education received. Hampton et al. (2013) found that 94.5% of participants either agreed or strongly agreed that women should receive fertility- awareness education when reporting difficulty conceiving, with 75.4% supporting that timing intercourse within the fertile window of the menstrual cycle can help some infertile couples to conceive naturally. Only 4.9% of women in the study by Hampton et al. (2013) had accessed a NFP teacher as a source of fertility- awareness education. Lastly, Righarts et al. (2017) noted that 23.3% of women had monitored ovulation in order to conceive. Moreover, 39.9% of women who had monitored to conceive were not able to recognize the optimal time for conception and only 16.8% of self-monitoring women had sufficient natural fertility knowledge. These results confirm that sufficient knowledge regarding fertility must be used in concert for fertility monitoring or tracking to be successful.

Women often seek out a variety of sources for learning about fertility- awareness; 49.5% of women studied by Hampton et al. (2013) and 25.9% of women studied by Righarts et al. (2017)

used Internet sites as a source for fertility- awareness education, and 30% and 33%, respectively, sought out non-specialist medical practitioners. If women in these studies were accessing unreliable, non-credible sources, that could not only negatively affect their fertility knowledge but also the efficacy of their chosen method.

In summary, the results of these studies support that women are interested and use ovulation monitoring when taught, but to date there is there is insufficient fertility- awareness education in practice to help women increase the probability of success.

Discussion

Findings from this review highlight three things: a) knowledge regarding time in the cycle in which to conceive was low among women studied; b) fertility- awareness practices were underutilized by women trying to conceive; and c) women desire fertility education and seek out information from a range of sources. While general fertility knowledge was moderate, knowledge regarding the time in the cycle in which to conceive was low. According to the results of these studies, women seeking pregnancy do not readily use FABM and/or often have a poor understanding of the fertile period. Women seek information regarding fertility from a variety of sources, and the studies showed that education regarding FABMs was desired but under-delivered. It is unclear if women request education regarding their most fertile time during routine pre-conception visits, and whether a discussion regarding FABMs is routinely part of a visit.

It is important for nurses, nurse practitioners, and nurse-midwives to proactively evaluate women's fertility knowledge. The authors of the studies reviewed here used a number of different instruments to evaluate fertility knowledge. The CFKS was used in three studies (Bunting et al., 2013; Fulford et al., 2013; Maeda et al., 2015), the Fert-AP survey was used in

one article (Childress et al., 2015), and in other studies the researchers developed their own questionnaires (Blake at al., 1997; Hampton et al., 2013; Hoffman et al., 2020; Mahey et al., 2018; Righarts et al., 2017). Instruments should evaluate both general fertility knowledge (modifiable and non-modifiable risk factors for infertility, such as age of fertility decline, smoking, weight, etc.) as well as fertility- awareness (indicators of ovulation). More recently developed instruments for assessing fertility knowledge include the Fertility and Infertility Treatment Knowledge Score (FIT-KS) and the Mu- Fertility Knowledge Assessment Scale. However, the application of such instruments outside of research and in clinical practice remains to be seen.

As an initial intervention, assessing a woman's knowledge can be followed by educating and encouraging the use of a FABM to aid her in identifying the fertile window. It is problematic in terms of best practices if women are referred to invasive, risky, and expensive procedures before basic fertility- awareness education is provided. There are personal, cultural, religious, and financial reasons why women may not choose to purse ART (Hampton et al., 2013). ART treatments also can be associated with greater risk of multiple gestations, miscarriages, and ectopic pregnancies (Patil, 2012). Risk for morbidity and mortality for women and newborns is increased as a result of these outcomes, as are length of hospital admissions, further increasing health care costs (Bromer et al., 2011). The median price of a cycle of in vitro fertilization in the United States, including medications, was $19,200 (estimated at $20,909.08 in fiscal year 2020), according to a 2015 report from the American Society for Reproductive Medicine (Daar et al., 2015; Wu et al., 2014). Therefore, it is essential that nurses, nurse practitioners, and nurse-midwives are well equipped to provide fertility- awareness education to women when first reporting difficulty conceiving (see Box 2).

Box 2. Components of FABM Education for Women

Cervical fluid method: Last day of slippery or stretchy cervical mucus and/or wet sensation signals ovulation. Adequate instruction from a trained instructor is optimal.

Basal body temperature method: Two to three days after ovulation, basal body temperature stays elevated until next menses. The lowest temperature before the rise signals ovulation.

Sympto-hormonal method: Use fertility monitor or urinary test strips to measure the presence of urinary metabolites of luteinizing hormone and estradiol to detect high- and peak-fertile days.

Calendar/rhythm method: Record cycle length for 6 to 12 months. Subtract 18 from number of days in shortest cycle; subtract 11 from number of days in longest cycle. Considered fertile within the range of dates calculated and update the calculations monthly.

Sympto-thermal method: Combination of cervical mucus, basal body temperature, and a cervical check. At ovulation, the cervix will rise, soften, and opening will become wide.

Standard days method: Women with regular cycles lasting 26 to 32 days can assume fertility-on days 8 to 19.

Limitations

Results of this review should be considered in the context of review limitations. Pertinent literature could have been missed based on the selection of keywords, databases, and search parameters (e.g., published studies, English language). Additionally, this review did not address disparities in fertility knowledge and fertility- awareness based on socioeconomic factors, nor the barriers to implementing FABM education with patients within the current health care system. Despite these limitations, an international perspective found common themes and important clinical implications were able to be highlighted.

Clinical Implications

There are implications for both nursing practice and nursing education. Implementation of fertility- awareness based education in practice is a safe and inexpensive initial intervention for women who report difficulty conceiving. Knowledge regarding fertility and the methods of fertility- awareness is essential to teach to both undergraduate and graduate nursing students, so that they may feel confident in providing education about FABMs to their future patients. Validity of fertility knowledge instruments and application of such instruments in clinical practice as it applies to women seeking conception is an area for future research.

Implications for Nursing Practice

Nurses, nurse practitioners, and nurse-midwives are the ideal practitioners to provide FABM education because nurses understand the art and science that is required of evidence-based FABM education. By providing accurate information and instruction to women regarding how to track and identify the fertile window, conception rates could improve, leading to less need for intervention with ART (Stanford et al., 2002; Manders et al., 2015). Barriers and facilitators to implementing FABMs in practice by general practitioners has been explored by Hampton et al. (2016) in an Australian population, but future research dedicated to identifying

barriers and facilitators for nurses practicing in the United States is essential for nurses to deliver FABM education. For nurses in search of a credible resource regarding FABMs, the mission of the Fertility Appreciation Collaborative to Teach the Science (FACTS) is to educate health care professionals about FABMs so that they may enable and encourage patients to care for their own fertility. The FACTS website offers information about each of the evidence-based FABMs as well as webinars, conferences, and speaker events (FACTS, n.d.).

Health care providers need not wait until a woman is expressing difficulty achieving. Mu et al. (2019) found a significant relationship between young women's knowledge about fertility and their fertility health risks. Education may help young women avoid fertility health risks and protect their current and future fertility. Women may also seek education regarding FABMs for the purpose to avoid pregnancy and this education is useful throughout reproductive life.

Implications for Nursing Education

For nurses, nurse practitioners, and nurse-midwives to feel confident in delivering essential FABM education, they must be educated regarding fertility as well. Fertility- awareness education includes a "physiological understanding of natural biological markers of fertility, the accuracy of those markers in relation to the day of ovulation, and the effectiveness of biological markers" (Fehring, 2004, p. 36). It is important for nursing students to have a strong foundation in these principles and be able to interpret the menstrual cycle. Additionally, it is essential that students have an understanding of all FABMs, including cervical mucus, calendar, basal body temperature, and urinary luteinizing hormone, so that as nurses, they can correctly help their patients identify the fertile window. Future research can be directed in how to best deliver this education to nursing students.

Recommendations for Future Research

Future research should focus on identifying which, if any, FABMs are discussed during pre-conception counseling visits and which FABMs practitioners are educating women to use. Additional research can also explore how confident providers feel in delivering FABM education to women prior to specialist referral. If providers lack confidence in this area, research should evaluate educational programs and explore how to best deliver educational interventions. If existing programs are not effective in increasing provider confidence than future research can include the design and validation of such programs. The content of such programs, in addition to how to best disseminate such programs, needs to be explored. Results from continued research in this area can inform future educational based interventions for increasing fertility awareness among women seeking pregnancy in addition to increasing confidence in FABM education for nurse practitioner and nurse-midwifery students.

Conclusion

This review has identified that women seeking pregnancy have low to moderate fertility knowledge and awareness, reinforcing the need for earlier identification and educational intervention by nurses. Nurses, nurse practitioners, and nurse-midwives should focus on providing fertility education to women prior to referral to ART. Establishing a baseline of a woman's fertility knowledge and her potential success with a FABM could spare women from the exorbitant cost, emotional strain, and potential complications of ART. Future research should consider the application of a validated fertility knowledge instrument to assess women's baseline knowledge in clinical practice.

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Conflict of Interest

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activity.

Figure 1 PRISMA[1] Search Strategy Flow Chart

| Identification | Records identified through database searching:

CINAHL (n=17)
MEDLINE (n= 32)
Web of Science (n=60) | Additional records identified through other sources:

Bibliographic search (n = 7)

Additional records identified through |

Records after duplicates removed
(n = 92)

Records screened using title and abstract (n = 92)

Records excluded, with reasons (n = 49)

Did not meet inclusion criteria, or did not meet the purpose of this integrative review

Full-text articles assessed for eligibility (n = 43)

- Full-text articles excluded, with reasons
- Efficacy of FABM (n=16)
- Evaluation of FABM website of mobile app (n=4)
- Not in English (n=3)
  Women not seeking conception (n=2)
- Not original research (n=7)
- Subfertile couples excluded in study (n=1)

Studies included in qualitative synthesis (n = 0)

Studies included in quantitative synthesis (meta-analysis) (n = 9)

[1]*PRISMA= Preferred Reporting Items for Systematic Reviews and Meta-Analyses.*
From: Moher,D., Liberati, A., Tetzlaff, J., & Altman, D.G., The PRISMA Group. (2009)

Table 1. Summary of the Study Findings- Data Extraction Matrix

Authors	Purpose	Sample/Setting	Results	QA[1]
Blake, Smith, Bargiacchi, France, & Gudex (1997)	To determine if menstruating women with a history of at least 2 years' infertility have an adequate understanding about the fertile time of their menstrual cycle	N= 80 women attending one infertility clinic	26% had a score indicating 'adequate' fertility- awareness. 46% had a score indicating no understanding of fertility symptoms or their meaning 15% knowledgeable about timing intercourse to align with perceived fertile time each month.	10
Hampton, Mazza, & Newton (2013)	To determine the fertility- awareness knowledge, attitudes, and practices of infertile women seeking fertility assistance	N= 204 women attending two ART[2] clinics	88.1% believed they were often or sometimes aware of their fertile days - Yet, only 12.7% graded as having high fertility- awareness 11.8% no fertility- awareness; 52.5 % poor fertility- awareness	16
Mahey, Gupta, Kandpal, Malhotra, Vanamail, Singh, & Kriplani (2018)	To evaluate fertility knowledge and awareness among infertile women attending a fertility clinic and their understanding of the menstrual cycle, how age affects fertility, and need for assisted fertility treatment	N=205 women attending one ART[2] clinic	85% failed to correctly identify the mid cycle as the most likely phase to achieve pregnancy - Knowledge was consistently poor among all SES[3] classes >85% were aware that young women are more fertile and it is easier to achieve pregnancy between 20-30 years. 26% could correctly identify > age 35 have greater difficulty in achieving pregnancy	12

Righarts, Dickson, Parkin, & Gillett (2017)	To examine the frequency of ovulation monitoring and its relationship with fertility knowledge and experience	N=1,034 women who had intended in the past or in the future to conceive, with many reported having experienced infertility	31.4% women reported ever using at least one method of ovulation monitoring. 23.3% of all women had monitored ovulation in order to conceive. 14.9% correctly identified the timing of the fertile window, 30.6% on the age at which fertility declines, 28.8% the likelihood of natural conception. 1.4% women answered all three questions correctly 39.9% of women who had monitored ovulation in order to conceive did not recognize that the optimal time to conceive is before ovulation. - Among women who were using ovulation monitoring, 16.8% had sufficient natural fertility knowledge.	10
Childress, Lawson, Ghant, Mendoza, Cardoza, Confino, & Marsh (2015)	To determine the impact of the initial infertility, visit on treatment-related knowledge, patient anxiety, and appraisal of treatment	N= 234 women attending their first infertility visit at an outpatient infertility clinic	- Knowledge score was high: $68.6 \pm 11.7\%$. - Missed items include: Correct labeling of the cervix (56.4%) and endometrial lining of the uterus (41%). - There was a significant improvement in post-visit knowledge scores and cumulative infertility/ ART[2] knowledge	15
Bunting, Tsibulsky, & Boivin (2013)	To examine fertility knowledge and treatment attitudes in men and women actively trying to conceive and to ascertain whether these varied across gender, country and selected individual and contextual factors	N=10,045 people currently trying to conceive (8,355 women, 1,690 men)	- Knowledge score on the CFKS[5] was modest: 56.9%. - Greater knowledge related to female gender, university education, paid employment, resides in a country with a very high Human Development Index, and prior medical consultation for infertility.	14

Fulford, Bunting, Tsibulsky, & Boivin (2013)	To investigate whether knowledge perceived susceptibility and infertility risk status relate to intentions to optimize fertility	1,345 childless women trying to conceive and having never engaged in fertility medical treatment	- The average correct score on the CFKS[5] was modest: 51.9% - Intentions to optimize fertility were lower among women who were heavy smokers and who had been trying to conceive for a year or more. - Intentions to optimize fertility were greater among those with a higher BMI[4], greater knowledge, and those who suspected a fertility problem.	13
Maeda, Sugimori, Nakamura, Kobayashi, Green, Suka, Okamoto, Boivin, & Saito (2015)	To examine fertility knowledge and the related factors for effective public education. Knowledge was investigated in 2 groups- a representative sample of the general population and a sample of people who were trying to conceive	N= 4,328 men and women in the general population; N= 618 men and women trying to conceive.	44.4% people in the general group answered items on the CFKS[5] correctly. 53.1% people in the trying to conceive group answered items on the CFKS[5] correctly - Those in the trying to conceive group's greater knowledge was associated with greater health literacy and prior medical consultation regarding their fertility.	13
Hoffman, Delaney, Valdes, Herrera, Washington, Aghajanova, Smith, & Herndon (2020)	To examine demographic predictors of fertility-related knowledge among infertile women from low and high-resource communities	N=143 infertile women desiring conception and presenting for initial care at fertility care centers	- The mean fertility knowledge score across all sites was 6.85 ± 2.5 (the composite knowledge score ranged from 0-11) - The score within the low-resource population was 5.3 ± 2.3 - The score within the high-resource population was 8.04 ± 2.3 - Statistically significant difference in fertility knowledge scores between patients from low-resource and high-resource settings - Education level was associated with fertility scores	13

[1]QA= Quality Appraisal; [2]ART= Artificial Reproductive Technology; [3]SES= socio-economic status; [4]BMI= body mass index; [5]CFKS= Cardiff Fertility Knowledge Score

Posttest

1. Which of the following best reflects fertility-awareness?

a. A woman's identification of her basal body temperature
b. A woman's identification of the exact date she begins ovulating
c. A woman's identification of the fertile and infertile phases of her cycle*
Rationale: Refer to section **About Fertility- Awareness**

2. Match the following term to the definition.

   a. Subfertility =   a. Taking longer than 6 cycles to achieve pregnancy*
   b. Infertility* =   b. No successful pregnancy after 12 cycles
   c. Sterility=   c. Inability to produce offspring
Rationale: Refer to section **Methods**

3. Which statement is true?

a. The terms infertility and sterility should be used interchangeably
b. The terms infertility and sterility should not be used interchangeably*
c. The term subfertility is a newer term in the field of fertility medicine
Rationale: Refer to section **Methods**

4. Which of the following are assessed in the Cardiff Fertility Knowledge Scale (CFKS)? (Select all that apply)

   a. The women's knowledge of fertile signs in a menstrual cycle
   b. The woman's knowledge of the definition of infertility*
   c. The woman's perceived infertility risk factors*
Rationale: Refer to section **Fertility Knowledge**

5. Which of the following characteristics would be most associated with a woman having higher risk for infertility? (Select all that apply)

   a. Being overweight
   b. Being underweight*
   c. Irregular menstrual cycles
   d. Smoking*
Rationale: Refer to section **About Infertility**

6. Using testing urine for metabolites of estradiol is an example of which fertility- awareness based method (FABM)?

a. Cervical fluid method
b. Sympto-hormonal method*
c. Sympto-thermal method

Rationale: Refer to **Box 2**

7. What is an important component to include in education about the standard days method of fertility- awareness?

a. Adequate instruction from a trained instructor is optimal.
b. A woman's menstrual cycle must be regular.*
c. A woman records her menstrual cycle for 6 to 12 months.

Rationale: Refer to **Box 2**

8. Women may choose to use fertility- awareness based methods for the following:

a. Assess tubal patency
b. Avoid pregnancy*
c. Explain assisted reproductive technology

Rationale: Refer to section **About Fertility- Awareness**

9. What is a potential benefit of nurses providing education on fertility- awareness based methods to patients?

a. Faster referral to assisted reproductive technology
b. Improved efficacy of assisted reproductive technology
c. Less need for assisted reproductive technology*

Rationale: Refer to section **Implications for Nursing Practice**

10. Which statement is most accurate about the results of the studies in this review?

a. Women had moderate knowledge regarding time in the cycle in which to conceive.
b. Women seek information on fertility education from a range of sources.*
c. Women trying to conceive underutilized fertility- awareness practices.

Rationale: Refer to section **Discussion**

Chapter III

Exploring Fertility-Awareness Practices Among Women Seeking Pregnancy

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Abstract

Objective: To explore use of fertility- awareness based methods (FABMs) and factors that influence their use.

Design*:* Secondary data analysis of the National Survey of Family Growth, 2015 to 2017.

Setting: Surveys were conducted in the homes of a national sample of women in the civilian, noninstitutionalized population of the United States.

Participants*:* A subset of women ($N = 423$) ages 19 to 49 years who sought advice about becoming pregnant.

Intervention/Measurements*:* Descriptive statistics and multivariate logistic regression were used to describe sample characteristics and to examine predictors for FABM use.

Results: The sample was primarily married (70%), non-Hispanic women age 35 years or older ($M = 37.4$ years, $SD = 7.3$). Most were college educated ($n = 253$, 74.4%), employed ($n = 317$, 74.9%), and had health insurance ($n = 392$, 92.7%). Only 113 women (27%) used one of three FABMs. The most frequent FABM was calendar rhythm ($n = 103$, 24.6%). Few used temperature/cervical mucus ($n = 33$, 7.9%) or Standard Days/Cycle Beads ($n = 25$, 6%). Catholic religion and age were not significant factors in FABM use. There was no significant difference among women with and without college degrees in FABM use: $\chi^2(1, N = 423) = .27$, $p = .60$. The model containing all predictors was not statistically significant: $\chi^2(6, N = 423) = 5.686$, $p < .459$; this indicates that the model was unable to distinguish differences in predictors between respondents who had or had not used a FABM. The model explained 1.7% (Cox and Snell R^2) and 2.5% (Nagelkerke R^2) of the variance in FABM use.

Conclusion: The most effective FABM (temperature/cervical mucus) was used infrequently among women who sought advice to achieve pregnancy. Although the effects were insignificant in predicting which women used an FABM, descriptive findings on FABM use were clinically informative. Considering the cost, emotional strain, and potential complications of infertility treatment, clinicians should consider initially recommending a fertility- awareness based method to women seeking advice about achieving pregnancy.

Keywords: female, fertility, fertility- awareness based methods, infertility, pregnancy

Precis statement: The most effective FABM for predicting ovulation in the data set (temperature/cervical mucus) was used infrequently among women who had sought advice on achieving pregnancy.

Clinical Implications:

- For women seeking pregnancy, it is important for nurses to identify which, if any, FABMs women have used when assisting them in choosing the most effective method.

- Nurses, nurse practitioners, and nurse-midwives are the ideal practitioners to deliver FABM education. based on their in-depth understanding of the meaning of the human person, human relationships, human sexuality, and transmission of life.

- Providing accurate information and instruction to women regarding identification of the fertile window may improve conception rates, subsequently reducing unnecessary medical intervention and costs.

- Providing fertility awareness education to women who report difficulty conceiving is a logical initial intervention.

Infertility, an important health issue nationally and globally, is defined as failure to establish a pregnancy after 12 months of regular, unprotected sexual intercourse. Data suggest that at least 50 million couples globally experience infertility (Mascarenhas et al., 2012). Fertility problems in the United States affect substantial numbers of women. Using data from the National Survey of Family Growth (NSFG) from 2015 to 2017, the Centers for Disease Control and Prevention (CDC) reported that 12.1% of women ages 15 to 44 years in the United States have difficulty getting pregnant or carrying a pregnancy to term. Consequently, the CDC estimated that 7.3 million women in the United States ages 15 to 44 years have used infertility services (CDC, 2019).

Assisted reproductive technology (ART) treatments to assist women in achieving pregnancy are not without risk. ART pregnancies are associated with greater risk of multiple gestations, miscarriages, and ectopic pregnancies. Such outcomes increase the risk not only for morbidity and mortality for women and newborns but also for increased length of admissions, thereby contributing to increased health care costs (Bromer et al., 2011). According to a 2015 report from the American Society for Reproductive Medicine, the median price of a cycle of in vitro fertilization in the United States, including medications, was $19,200 (Daar et al., 2015; Wu et al., 2014). Women may not want to pursue ART due to personal, cultural, religious, or financial reasons (Hampton et al., 2013).

It is problematic if women are referred for invasive, risky, and expensive procedures before basic fertility awareness education is provided. Importantly, women's inaccurate identification of the fertile window (e.g., fertility awareness) can contribute to infertility (Hampton et al., 2013). Fertility- awareness is defined as a woman's understanding of human

reproduction as it relates to fertility. Thus, use of fertility- awareness based methods (FABMs) can be considered an initial intervention for decreasing infertility.

If a woman desires conception, she should engage in intercourse around the time of ovulation. Several evidenced-based FABMs predict ovulation and estimate peak fertility. FABMs include observations of the cervical mucus, basal body temperature charting, calendar calculation, or detection of urinary luteinizing hormone. Each FABM has advantages and limitations, and fertility- awareness education can help women and couples choose the approach best aligned with their personal goals.

Lack of knowledge and awareness of fertility has been reported as problematic among women seeking to become pregnant. Hampton et al. (2013) found that only 12.7% of participants ($n = 204$) seeking fertility assistance were able to demonstrate accurate knowledge of the mucus or temperature method for predicting ovulation. Similarly, Righarts et al. (2017) determined that only 23.3% of all women in their study ($n = 1,034$) had monitored ovulation to conceive. Furthermore, few (14.9%) were able to correctly identify the timing of the fertile window. In sum, evidence suggests that women seeking pregnancy do not readily use FABMs and/or often have a poor understanding of the fertile period.

The American College of Obstetricians and Gynecologists and the American Society for Reproductive Medicine (2019) recommend that an infertility evaluation be offered to any woman who by definition has infertility or is at increased risk for infertility. Factors to elicit during the history interview with a woman include her identification of signs of ovulation. Signs of ovulation include positive ovulation tests, cervical mucus changes, or biphasic basal body temperatures. For a diagnosis of unexplained infertility, the American College of Obstetricians and Gynecologists concludes that a woman should have evidence of ovulation, tubal patency,

and a male partner's normal semen analysis. There is no standard for how health care providers review a woman's ovulation tracking methods to establish evidence of ovulation before referral to ART. Existing barriers to providing FABM education may contribute to why women in previous studies were found to have low fertility knowledge and awareness. In Australia, barriers to implementing FABM education to women include (a) resources (e.g., time, materials, and reimbursement), (b) clinician knowledge and skill, and (c) medical dominance (Hampton et al., 2016). Clinicians in the United States likely face similar barriers. Therefore, the probability exists that ART referrals may occur before it is known whether a woman is engaging in intercourse at the correct time in her cycle. Therefore, our purpose in this secondary data analysis study was to explore the use of FABMs by using the NSFG. A secondary aim was to examine factors that influence women's decision to use an FABM among those who had sought advice about conceiving.

Theoretical Framework

The Traits–Desires–Intentions–Behavior (TDIB) theoretical framework was developed to conceptualize the social and behavioral motivations one has for childbearing (Miller, 1994). The framework, a four-step sequence, includes the formation of traits, activation of traits into desires, translation of desires into intentions, and implementation of intentions in the form of behavior (Miller, 1994). The framework is based on the construct of motivation, with other constructs (e.g., attitudes, values, norms, desires, and intentions) integrated into it. The TDIB theoretical framework has been used in research to examine differences in family planning choices among specific groups, because it acknowledges that there are important factors that may affect behavior (Wagner et al., 2014). The TDIB model guided the selection of key variables, or traits,

related to FABM use among women who had sought advice on achieving pregnancy because it examines the predictors of reproductive decision making and behavior (see Figure 1).

Figure 1. The Traits-Desires-Intention-Behavior Theoretical Framework
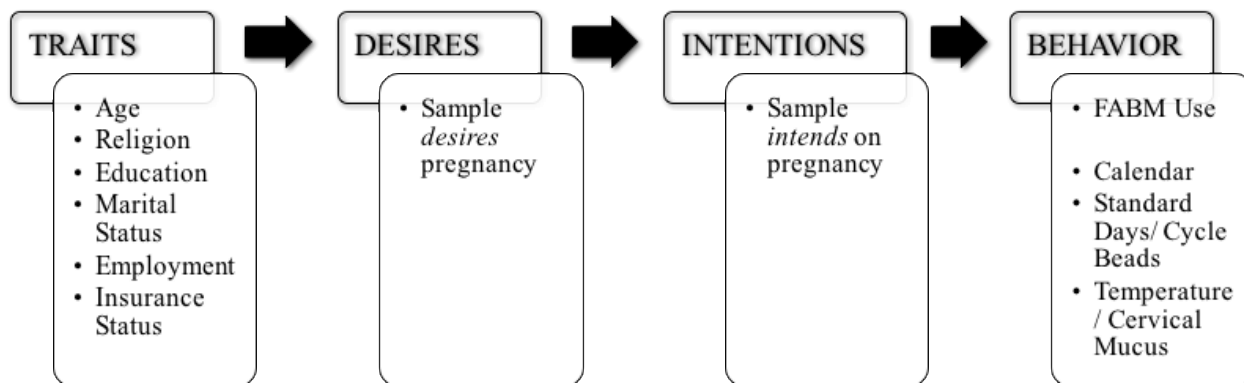
Note. FABM= fertility- awareness based method

Methods

Design

We conducted a secondary data analysis of the NSFG, 2015 to 2017. The NSFG was established by the CDC's National Center for Health Statistics for the purpose of obtaining detailed information on family formation and reproductive health. The NSFG is a cross-sectional study and is based on a stratified multistage area probability sample design to produce a national representation of women 15 to 44 years old who depict the civilian, noninstitutionalized population of the United States. The NSFG 2015 to 2017 survey was administered through voluntary, confidential, in-person interviews in collaboration with interviewers from the University of Michigan. Responses to sensitive questions were collected privately through self-administration via an audio computer-assisted self-interviewing system. Data collection was approved by National Center for Health Statistics/CDC and the University of Michigan

institutional review boards. The 2015 to 2017 NSFG public-use files include data from 5,540

women and 4,540 men interviewed between September 2015 and September 2017. The NSFG

survey is authorized by a federal law, the Public Health Service Act (1944). The NSFG survey

included three FABMs: (a) the calendar/rhythm method, (b) the Standard Days Method or Cycle

Beads, or (c) use of a cervical mucus/temperature method. Names of the methods associated with

cervical mucus/temperature method that were explicitly stated in the survey were the TwoDay

Method, Billings Ovulation Method, and symptothermal method. Descriptions of the FABM

methods included in the NSFG survey are outlined in Table 1. Additional ethical review was not

necessary for this secondary data analysis.

Table 1.

Table 1. Fertility-awareness based methods in the NSFG survey

FABM	Description	Resources
Cervical Mucus Method	• The woman checks vaginal sensation and presence of mucus each time she uses the bathroom. • The last day of slippery or stretchy mucus and/or wet sensation signals ovulation.	Billings Ovulation Method ® https://www.boma-usa.org/ Creighton Model FertilityCare™ System https://www.creightonmodel.com/ TwoDay Method®

	• Adequate instruction from a trained instructor is optimal regarding the interpretation of her cervical mucus observations.	https://www.twodaymethod.com/
Basal Body Temperature (BBT)	• Before ovulation, temperature ranges from 97.2-97.7 degrees F. • Two to three days after ovulation, hormonal changes cause a rise of 0.4-1.0-degree F in temperature which stays elevated until next menses. • Lowest temperature before the rise signals ovulation.	Basal Body Thermometers available at most pharmacies over the counter. Downloadable temperature tracking charts and apps free online. Examples: https://www.tcoyf.com/downloadable-charts/, https://mymonthlycycles.com/bbtchartdl.jsp, Kindara app, Ovia app

Symptothermal Method	• Combination of cervical mucus method, BBT, and a cervical check, where the woman notes the position and consistency of the cervix. • At ovulation, the cervix will rise, soften and the opening will become wide.	Couple-to-Couple League https://ccli.org/ SymptoPro™ Fertility Education https://www.symptopro.org/
Calendar/Rhythm Method	• The woman records the number of days in her cycle for 6-12 months. • She subtracts 18 from the total number of days in her shortest cycle and 11 from the total	Any calendar the woman prefers may be used

	number of days in her longest cycle. • She considers herself fertile within the range of days calculated, and updates the calculations monthly	
Standard Days Method®	• Can only be used for women with cycles lasting 26-32 days. • Identifies that a woman is fertile days 8-19 of her cycle • The woman can track where she is in her cycle using a string of color-coded beads, called Cycle Beads®	CycleBeads® https://www.cyclebeads.com/

Participants

The female respondent survey was used for the analysis. Case selection was restricted to the subset of women ages 19 to 49 years ($N = 423$) who reported "yes" on the survey to having ever sought medical advice from a health care provider about achieving pregnancy. Seeking health care advice about achieving pregnancy and FABM use were used to indicate desire, intention, and behavior, respectively, in the theoretical TDIB model. Thus, seeking such advice about achieving pregnancy served as proxy for case selection.

Data Analysis

Descriptive statistics were used to describe the frequency of use of each of the three FABMs identified. Characteristics of the predictor variables based on the TDIB framework included age, marital status, employment, insurance status, education, and religion. Means and standard deviations or frequencies and percentages were used as appropriate. Frequencies were determined on individual FABMs. A composite of all three methods was created for the regression model. Multivariate logistic regression was used to examine the effect of several independent variables (e.g., age, marital status, employment, insurance status, education, religion) on the dependent variable of interest (FABM use) with a level of significance of $p \leq .05$. Employment, insurance status, marital status, college education, and religion (as Catholic or not) were dichotomized. Catholic religion was chosen among the other religions listed in the survey because of the Catholic church's historic opposition to unnatural forms of contraception and ART (Paul VI, 1968, Section II). Age was dichotomized based on a definition of advanced maternal age as 35 years or older. Age older than 35 years was coded as 1, and age 34 years or younger was coded as 0. The decision to dichotomize age was based on the clinical guidelines to refer women to infertility services after 6 months of unsuccessful conception if

older than 35 years and after 12 months if younger than 35 years. All analyses were conducted with IBM SPSS (Version 26).

Results

The sample comprised primarily married (70%), non-Hispanic women of advanced maternal age (M = 37.4 years, SD = 7.3). Most were college educated (n = 253, 74.4%), were employed (n = 317, 74.1%), and had health insurance (n = 392, 92.7%). Characteristics of the sample are highlighted in Table 2. Only 27% of participants used one of three FABMs. The most frequently used FABM was calendar rhythm (n = 103, 24.6%). Few participants used temperature/cervical mucus (n = 33, 7.9%) or Standard Days/Cycle Beads (n = 25, 6%). Catholic religion and age were not significant factors in FABM use. Figure 2 depicts FABM use among women who had sought conception advice. There was no statistically significant difference among women with and without college degrees in use of FABM: χ^2(1, N = 423) = .27, p = .60.

Table 2. Sociodemographic Characteristics (n=423)

Characteristics	%
Age ≥35	64.8
Age <35	35.2
Non-Hispanic	83.7
Hispanic	16.3
Married	70.0
Never married	14.7
Divorced	10.4
Separated	3.5
Widowed	0.9

College Degree	74.4
Without College Degree	25.6
Health Insured	92.7
Non-Health Insured	7.3
Employed	74.9
Unemployed	25.1
Catholic	17.1
Other Religion/No Religion	82.9

Figure 2. FABM Use
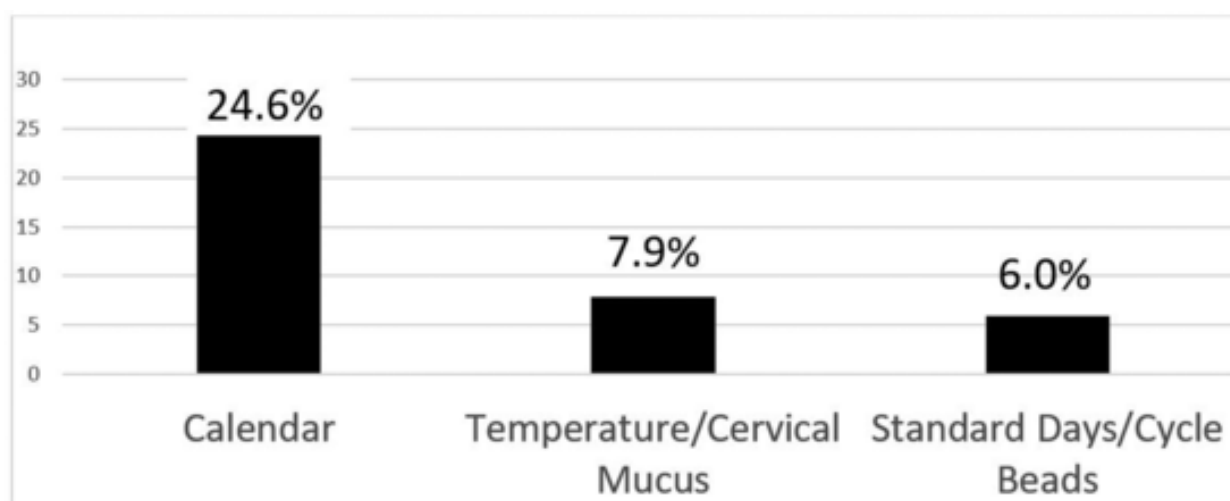
Note. FABM= fertility- awareness based method

Logistic regression was performed to assess the impact of several factors on the likelihood that respondents reported use of FABM. The model contained six independent variables (age, marital status, education, religion, employment, and insurance status). The full model containing all predictors was not statistically significant: $\chi^2(6, N = 423) = 5.686, p < .459$; this indicates that the model was unable to distinguish differences in predictors between respondents who had and who had not used an FABM. The model as a whole explained just 1.7% (Cox and Snell R^2) and

2.5% (Nagelkerke R^2) of the variance in FABM use. As shown in Table 3, none of the independent variables from the TDIB framework made a unique statistically significant contribution to the model.

Table 3. Predictors of FABM Use

	B	S.E.	Wald	df	Sig	Exp (B)
Age $\geq$ 35 years	.134	.266	.254	1	.614	1.143
Married	-.564	.313	3.242	1	.072	.569
College Degree	.091	.294	.095	1	.758	1.095
Catholic	.333	.353	.889	1	.346	1.395
Employed	-.179	.309	.337	1	.562	.836
Health Insured	.707	.568	1.549	1	.213	2.029
Constant	-1.212	.341	12.656	1	.000	.298

Note. Variables were dichotomized. See Table 2 for categories of variables collapsed into comparison groups (e.g. married =1; never married, divorced, separated, widowed collapsed and coded as 0). FABM= fertility- awareness based method.

Discussion

Our primary aim to explore FABM use indicated that few women use FABMs in general. Interestingly, the most effective FABM for predicting ovulation in the data set (temperature/cervical mucus) was used infrequently among women who sought advice on achieving pregnancy. Temperature and/or cervical mucus methods rely on biomarkers to predict ovulation, making these methods more accurate for predicting ovulation than the other FABMs surveyed (Bigelow et al., 2004; Ecochard et al., 2015; Scarpa et al., 2007; Stanford et al., 2020). The most frequently used FABM in the data set sample was the calendar method. The calendar

method is useful in women with consistent, regular menstrual cycles. Conversely, the calendar method is difficult for women with irregular cycles, because it provides only a rough estimate of the fertile time using calculations from the lengths of previous cycles. Although it is based on ovulation occurring approximately 2 weeks before menstruation regardless of the length of a woman's menstrual cycle, it can be difficult for women with irregular cycles to predict when menstruation will occur (World Health Organization, 1988). Normal cycles can have a variation of a few days and do not necessarily imply diagnoses of polycystic ovary syndrome or amenorrhea.

None of the factors selected as traits using the TDIB framework influenced or significantly predicted a woman's decision to use FABM. However, it is important to consider that statistical and clinical significance are not synonymous. The results may indicate that women across ages, marital status, employment, education, insurance status, and religion have equal likelihood of using an FABM. FABM counseling may be an appropriate initial intervention across a broad demographic of women seeking advice on achieving pregnancy. Further research to consider how to best deliver FABM education to increase FABM use is needed.

Limitations

The NSFG survey questions regarding historic use of an FABM appear in the contraceptive history section of the survey. Respondents were asked if they had ever used the rhythm method, Standard Days/Cycle Beads method, or temperature/cervical mucus method to avoid pregnancy. Unlike other methods of contraception (e.g., intrauterine devices, pills, implants, injections, transdermal patches), FABMs can be used to avoid or achieve pregnancy. If a woman had ever used a method to predict her fertile window to avoid pregnancy, then she would also know how to use it to achieve pregnancy. However, respondents who may have used

an FABM for the purpose of pregnancy intention at one time but used other forms for the

purpose of contraception could have answered "no" and be missing from the subset. A woman's

intent to conceive may direct her knowledge in seeking and adhering to an FABM. Not all

FABMs were included in the survey. Specifically, methods that include ovulation prediction by

urinary luteinizing hormone or app-based methods were not included. Another limitation is that

it is unknown if women in the sample met criteria for an infertility diagnosis. The data did not

include how long women were trying to achieve pregnancy before seeking advice from a

provider. Finally, although sampling strategies for the survey produced a nationally

representative sample, the selection of cases to explore the subset of women of interest in this

analysis yielded homogenous demographics.

Implications for Nursing Practice

In this study, we show that FABMs were underused among women who had sought

pregnancy advice. According to Fehring (2004), "contemporary education in NFP (natural family

planning, or fertility- awareness), is complex, involving science, philosophy, and art." Providing

accurate information and instruction on how to identify the fertile window may improve

conception rates and subsequently reduce unnecessary medical intervention and costs (Manders

et al., 2015; Stanford et al., 2002). Providing fertility- awareness education to women who report

difficulty conceiving is a logical initial intervention.

There are a number of credible resources available for clinicians to learn a FABM and/or

to refer women who are interested in learning a FABM. The method of tracking the cycle by

using a cervical mucus method can be taught by a certified natural family teacher of the Billings

Ovulation Method or the Creighton Model FertilityCare System. Women and their health care

providers can log on to the respective websites to search for a teacher in their geographic

location. Instructions and resources for the TwoDay Method, another cervical mucus method, can be accessed online. If women choose to track using the temperature method, charts are free online, and basal body thermometers are available at most pharmacies over the counter. For women who prefer tracking using cervical mucus, temperature, and position of the cervix, the symptothermal method is taught through the Couple-to-Couple League. Women can search for teachers in their geographic location for this method as well. The calendar or rhythm method can be used with any calendar that a woman prefers paired with some basic mathematic calculations. Women with cycles lasting between 26 and 32 days can track their cycle using the Standard Days Method using a string of color-coded beads, called CycleBeads. Although the NSFG survey did not include detection of the luteinizing hormone and estrogen in the urine using an over-the-counter ovulation prediction kit, this is another FABM that can be taught by a Marquette Method instructor. It is important for clinicians to be knowledgeable about the resources available to women as well as the ability to interpret women's FABM charts.

Conclusion

Considering the cost, emotional strain, and potential complications of ART, practitioners should consider encouraging women to try an FABM before referring them for ART. In this study, the most accurate method of predicting ovulation to enhance conception among those included in the NSFG survey is underused. Future research is needed to explore which, if any, FABMs are discussed during preconception counseling visits and which FABMs are subsequently used by women. Results can then be used to inform future educational interventions for increasing fertility- awareness among women desiring pregnancy.

Chapter IV

Factors that Contribute to Fertility-Awareness Based Method Use

Among Women Trying to Conceive

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Abstract

Background: Unexplained infertility is diagnosed when a woman or couple have evidence of ovulation, tubal patency, and a normal semen analysis. Yet, evidence of ovulation is limited by patient self-report and women's inaccurate identification of the fertile window (i.e. fertility-awareness). For women trying to conceive, it is important to assess their method of fertility-awareness, as the use of evidence-based fertility-awareness based method (FABM) could be an initial intervention for decreasing unexplained infertility. Little is known about women's fertility tracking behaviors among those who are currently, or will soon be, trying to conceive.

Objective(s): To explore predictors of fertility awareness-based method use among women trying to conceive or who are contemplating pregnancy within the next year.

Study Design: Data were drawn from participants in the Nurses' Health Study 3, a prospective cohort study. Participants were included who reported that they intended to become pregnant when first asked about their pregnancy intentions. Use of fertility awareness-based method(s) to monitor the menstrual cycle for signs of ovulation was self-reported on the questionnaire. Descriptive statistics, t-tests, and chi-squares were used to compare the "actively trying" group to the "contemplating pregnancy within the next year" group. Multivariable negative binomial regression was used to identify predictors for number of methods used, as data on seven methods of fertility awareness were collected.

Results: Among participants for this analysis (n=3,175), 952 were trying to conceive and 2,223 reported that they were contemplating pregnancy within the next year. Participants with a history of infertility were more likely to be actively trying (n=227, 24.2%) than those who stated they were contemplating pregnancy (n=186, 8.4%, p <0.001). The three most commonly used fertility

awareness-based methods for women actively trying were keeping track of the menstrual cycle (n=691, 72.6%,), ovulation predictor kits (n=400, 42.0%), and cervical mucus monitoring (n=393, 41.3%). In comparison, the three most commonly used methods among women contemplating pregnancy were keeping track of the menstrual cycle (n=833, 37.5%), cervical mucus (n=504, 22.7%), and basal body temperature monitoring (n=103, 4.6%). The total number of fertility methods used were modeled using a negative binomial-log model. Women who had been trying for 3-5 months used on average 30% more fertility methods compared with women who had been trying for 1 month or less-2 months (i.e., 0.26 $\pm$ 0.07 methods). Women who had been trying for 6-12 months used on average 44% more fertility methods compared with women who had been trying for 1 month or less-2 months (i.e., 0.36 $\pm$ 0.06 methods). Women who had been trying for 1-3 years used on average 38% more fertility methods compared with women who had been trying for 1 month or less-2 months (i.e., 0.32 $\pm$0.06 methods). Among women contemplating pregnancy, women who are married or in a domestic partnership used on average 26% more fertility methods compared with women who have never been married, divorced, separated, or widowed (i.e., 0.23 $\pm$0.06.) Women with a history of infertility used on average 22% more fertility methods compared with women without history of infertility (i.e., 0.20 $\pm$0.10.)

Conclusion(s): Duration of ongoing pregnancy attempt was the only significant factor in predicting number of fertility-awareness based methods used among women actively trying to conceive, whereas partnership and history of infertility were the only significant factor in predicting the number of fertility-awareness based methods used among woman contemplating pregnancy within the next year. Well established methods to track fertility were underutilized among all women.

Introduction

Infertility is a source of significant distress to women, their partners, and their families. Approximately 12.1% of childbearing-aged women in the United States have difficulty getting pregnant or carrying a pregnancy to term annually, and an estimated 7.3 million have used infertility services (CDC, 2021). Unexplained infertility is diagnosed when a woman or couple have evidence of ovulation, tubal patency, and a normal semen analysis (ACOG, 2019). Yet, evidence of ovulation is limited by patient self-report and women's inaccurate identification of the fertile window (i.e. fertility- awareness). It has been identified that these factors can contribute to unexplained infertility (Hampton et al., 2013).

Research has shown that among infertile women and women seeking pregnancy, women have limited knowledge regarding the menstrual cycle, ovulation, and the fertile window (Blake et al., 1997; Hampton et al., 2013; Mahey et al., 2018; Righarts et al., 2017; Perez Capotosto, 2021). Moreover, there is no standard practice for how health care providers review a woman's ovulation tracking methods that are needed to establish evidence of ovulation before referral to assisted reproductive technology (ART). Superfluous referral to ART can lead to costly, invasive, and risky interventions (Hampton et al., 2013). Alternatively, the use of evidenced-based fertility-awareness based methods (FABMs) can assist women to predict ovulation and estimate peak fertility. A brief description of these fertility-awareness-based methods are included in Supplemental Table 1. For women trying to conceive, it is important to assess their method of fertility- awareness, as the use of evidence-based fertility-awareness-based method(s) could be an initial intervention for decreasing infertility. Hence, the aim of this study was to

explore predictors of the number of fertility-awareness based method use among women actively trying to achieve conception and among women contemplating pregnancy within the next year.

Materials and Methods

The Nurses' Health Study 3 (NHS 3) is an ongoing, prospective Internet-based cohort study of nurses in the United States and Canada. Recruitment for the third iteration of Nurses' Health Studies began in 2010 and more than 45,000 female and male nurses aged 19-49 years residing in the United States and Canada participate. NHS 3 participants include female or male nurses (currently working, not working, students working towards any level of nursing degree, or retired) over aged 18, but born after January 1st, 1965. Every 6 months, questionnaires are sent to participants to update lifestyle and medical characteristics. Part of the NHS 3 design is to allow non-gender conforming individuals the option to fill out either the female or male questionnaire, therefore, only individuals that self-select the female questionnaire were included in this analysis. Four pregnancy intention questions were integrated in the female questionnaire as of January 15th, 2015; these questions were featured in the baseline questionnaire as well as follow-up questionnaires. As of May 2021, 25,612 women had been asked the four pregnancy intention questions in either their baseline survey or at least one of their follow-up surveys forming the base population for our analysis. Our preliminary approach to address the research question was to look at women's first report of pregnancy intention. An overview of the study flow is illustrated in Supplemental Figure 1. Briefly, participants were eligible for the analysis if they chose to answer the female questionnaire at registration, had completed the baseline questionnaire, and reported that they ether were actively trying to achieve pregnancy (n=954) or may become pregnant within the next year (n=2,282). Participants who had missing information on age (n=1), duration of ongoing pregnancy attempt (n=1), marital status (n=5) and history of

infertility (n=54) were excluded from the analysis. After these exclusions, 3,175 women were

available for analysis.

Data collection for the Nurses' Health Study 3 was approved by the Harvard-affiliated

Partners Healthcare Institutional Committee for the Protection of Human Subjects in Research.

Additional ethical review for this analysis was exempted by the Boston College institutional

review board. Participant data is secure and identified by study ID only. The cohort data is

maintained on a private cluster consisting of 200 UNIX and Linux servers, a 400-terabyte

multitiered Avere-Isilon storage system, and an EMC NetWorker backup system.

Case selection was restricted to the subset of women who report either "Yes, actively

trying" or "Yes, may become pregnant within the next year" to the question: "Are you actively

trying to become pregnant or do you think that you may become pregnant at some point within

the next year?" Women who indicated that they were actively trying to achieve pregnancy were

then asked to report the current duration of their ongoing pregnancy attempt. Specifically,

women were asked: "For how many months have you been actively trying to get pregnant?"

Categories for response include: <1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 months, 1-2 years, and 3+

years. The outcome of interest was the answers to the following two questions, which were

offered to both the actively trying group and the may become pregnant within the next year

group: "Do you monitor your menstrual cycle for signs of ovulation?" and "How do you monitor

your cycle?" Women may select from a list of eight fertility-awareness based methods of

ovulation tracking, with the option of choosing all that may apply. The fertility-awareness based

methods included in the survey were as follows: 1) tracking menstrual cycle length, 2) basal

body temperature monitoring, 3) cervical mucus monitoring, 4) ovulation prediction kits, such as

Clearblue® EASY ovulation test, 5) fertility monitors that use urine samples, such as Clearblue®

Monitor, 6) fertility monitors that use saliva samples, such as OvaCue® Monitor, and 7) saliva "ferning" microscopes, such as Fertile-Focus, Ovulens, and 8) other.

Information on potential confounding variables was assessed on the baseline questionnaire, including age, marital status, education, employment, lifetime number of pregnancies, history of infertility, BMI, smoking, as well as self-reported chronic health conditions such as anxiety, depression, uterine fibroids, endometriosis, Grave's disease, hypothyroidism, high blood pressure, elevated cholesterol, diabetes, and PCOS. We identified these variables *a priori* based on other factors in previous studies that have been shown to affect women's desires, intentions, and behaviors related to family planning decisions and fertility-awareness based method(s) use (Wagner et al., 2014; Amutah et al., 2016; Mynarska & Rytel, 2018; Finocchario-Kessler et al., 2010). Table 2. details the *a priori* covariate testing for each variable's univariate relationship with number of fertility methods, as well as the variables significance in the multivariable model. Factors with a *p* value <0.20 were entered into the model before backward stepwise selection. Backward stepwise modeling was the approach to decide which covariates were retained in the models. Variables were removed if their significance is *p* ≥ 0.05 until we retained variables that had a *p* <0.05. Variables entered into the multivariable models for women who were actively trying to achieve pregnancy were age, PCOS, lifetime number of pregnancies, BMI, and duration of ongoing pregnancy attempt. After backward stepwise modeling, current duration of pregnancy attempt was the only variable that was retained. Variables entered into the multivariable models for women who may become pregnant within the next year were age, marital status, history of infertility, lifetime number of pregnancies, history of uterine fibroids, and history of Grave's disease. After backward stepwise modeling, history of infertility, marital status, history of uterine fibroids, and history of Grave's

disease were retained. Age was entered into both models because of its clinical significance

(Table 2).

Duration of time trying to conceive was grouped into those trying for less than 1 month-2

months, 3-5 months, 6 months-12 months, and 1-3 years or more. The decision to group duration

of time trying to conceive was based on clinical guidelines for referral to fertility services, as

women aged over 35 are referred after 6 months if unsuccessful and women aged under 35 are

referred after 12 months of trying. Marital status was grouped into women who were partnered

(married or domestic partnership) and those unpartnered (never married, separated, divorced, and

widowed). Number of pregnancies was grouped into never been pregnant, history of one

pregnancy, and history of two or more pregnancies.

Descriptive analysis included the inspection of missing data and extreme values, an

assessment of potential confounders, and the characteristics of the sample, including age, race-

ethnicity, marital status, income, geographic location, employment, and education status.

Demographic information was self-reported and these classifications were defined by the

participant. Continuous variables were reported as mean and standard deviation and categorical

variables were reported as frequency and percentages. Frequencies were obtained on the FABMs

individually. Differences in factors among the "actively trying" group to the "contemplating

pregnancy" group were compared using the appropriate statistical tests (ie, t test, Chi-square

test). Associations between the number of fertility-awareness based methods used and predictive

factors were generated for context and comparison through negative binomial regression for both

the "actively trying" and "contemplating pregnancy " groups. All analyses were conducted in

Stata (version 17) within the Unix environment (StataCorp LLC, 2021). A significance level of

$P<0.05$ was used for all analyses.

Results

There were 3,175 women eligible for our analysis; 952 women who were actively trying to achieve pregnancy and 2,223 women who reported they may become pregnant within the next year. Characteristics of the sample are provided in Table 1. In brief, the total sample was primarily white (92.2%), non-Hispanic or Latina (95.5%), women with mean age 29.6 years $\pm$ 4.4. Most were employed (94.1%) and married or in domestic partnership (54.5%). Comparatively, woman who stated that they were contemplating pregnancy (n=2,223) were slightly younger (29.3 years old $\pm$ 4.3 years) than women who were actively trying to achieve conception (n=952, 30.3 years old $\pm$ 4.5 years), and less likely to be married or in a domestic partnership (51.6%). In terms of physical characteristics, women actively trying to conceive had a slightly higher BMI (25.99 $\pm$ 6.66), as well as were more likely to have PCOS (11.8%), endometriosis (4.6%) and hypothyroidism (3.1%) than the women who were contemplating pregnancy. The most significant difference was among those with a history of infertility, which was more common in women actively trying (n=227, 24.2%) than women who stated that they may become pregnant within the next year (n=186, 8.4%, p <0.001). Women who were actively trying to conceive had higher rates of monitoring their cycles for signs of ovulation than women who stated they may become pregnant within the next year (p<0.001). For each of the eight methods of fertility-awareness based methods offered in the survey, there were statistically significant differences in the utilization, as women actively trying to conceived used all methods with greater frequency than women who may become pregnant within the next year. The three most commonly used fertility- awareness based methods for women actively trying were keeping track of the menstrual cycle (n=691, 72.6%,), ovulation predictor kits (n=400, 42.0%), and cervical mucus monitoring (n=393, 41.3%). In comparison, the three most commonly used

methods among women who may become pregnant within the next year were keeping track of the menstrual cycle, (n=833, 37.5%), cervical mucus (n=504, 22.7%), and basal body temperature monitoring (n=103, 4.6%). (Figure 1). Women actively trying to achieve used 1.84 ± 1.24 fertility methods, whereas women who stated that they may become pregnant within the next year only used 0.75 ± 1.01. (Supplemental Figure 2).

For women actively trying to conceive, the total number of fertility methods used were modeled as a function of age and duration of time trying to conceive using a negative binomial-log model. Women who had been trying for 3-5 months used on average 30% more fertility methods compared with women who had been trying for 1 month or less-2 months (i.e., 0.26 ± 0.07 methods). Women who had been trying 6-12 months used on average 44% more fertility methods compared with women who had been trying for 1 month or less-2 months (i.e., 0.36 ± 0.06 methods). Women who had been trying for 1-3 years used on average 38% more fertility methods compared with women who had been trying for 1 month or less- 2 months (i.e., 0.32 ±0.06 methods). Figure 2 depicts the specific fertility methods used and their frequency by duration of time trying to conceive. Although age was retained in the model secondary to referral guidelines to infertility based on age and duration of months trying, there were no differences in the number of methods used based on age. A negative binomial- log model adjusted for over-dispersion was also used to identify predictors for the number of fertility methods used for women who stated they were contemplating pregnancy. Women who are married or in a domestic partnership used on average 26% more fertility methods compared with women who have never been married, divorced, separated, or widowed (i.e., 0.23 ±0.06.) Women with a history of infertility used on average 22% more fertility methods compared with women without

history of infertility (i.e., 0.20 $\pm$0.10.) There were no significant differences in number of method use based on age or history of grave's disease. (Table 3).

We also examined predictors for any use of a fertility-awareness based method, rather than number of fertility methods used, to see if our conclusions changed. Results of the multivariate logistic regression model predicting use of any FABM are presented in Supplemental Tables 2 and 3. As shown in Supplemental Table 3, only three independent variables made a unique statistically significant contribution to the model (duration of time trying to conceive, pregnancy history, and PCOS). Odds are 82% greater that women who had been trying for 3-5 months will use any FABM compared to women who had been trying for less than 1 month-2months. Odds are 97% greater that women who had been trying for 6-12 months will use any FABM compared to women who had been trying for less than 1 month -2 months. Odds are 76% greater that women who had been trying for 1-3 years of more will use any FABM compared to women who had been trying for less than 1 month-2 months. Women who had a history of two or more pregnancies were 53% less likely to use a FABM compared to women who had never been pregnant. Women who self-reported PCOS were 65% less likely to use a FABM compared to women without PCOS. Age, depression, or anxiety were not significant factors in predicting the use of a FABM among women actively trying to conceive. For women who were stated that they were contemplating pregnancy, women who are either married or in a domestic partnership had an 36% increase in the likelihood of using any FABM compared to women who are single, widowed, never married, or divorced. History of infertility, number of pregnancies, and endometriosis were not significant factors in predicting the use of a FABM among women contemplating pregnancy. The results of the multivariate logistic regression to

predict any use of a fertility-awareness-based method are similar to that of the negative binomial regression to predict number of fertility-awareness-based methods.

Comment

Principal Findings

Well established methods to track fertility were underutilized among all women. Our analysis found that there are differences between women actively trying to conceive and women contemplating pregnancy in terms of method preferences, number of methods, and predictors for how many methods are used. Duration of ongoing pregnancy attempt was the only significant factor in predicting number of fertility-awareness based methods used among women actively trying to conceive, whereas partnership was the only significant factor in predicting the number of fertility-awareness based methods used among woman who may become pregnant within the next year.

Results in the Context of What is Known

Our results agree with previous studies that have also shown that fertility-awareness based methods are underutilized among women who actively seek conception (Blake et al., 1997, Hampton et al., 2013, Perez Capotosto et al., 2020). Similar to the study done by Perez Capotosto et al., 2020, the most frequently used fertility method, was keeping track of the menstrual cycle length, which is also often referred to as the calendar method. This is a useful method for women with consistent and regular cycles, as ovulation occurs approximately 2 weeks before menstruation regardless of cycle length. However, this method, like basal body temperature monitoring and cervical mucus monitoring, relies on the interpretation of trends from previous cycles, because it retrospectively provides information of when the woman experienced ovulation. Conversely, methods such as ovulation prediction kits, fertility methods

that use urine or saliva, and saliva microscopes allow women to have information on ovulation within the current cycle. Well established methods to track when ovulation would occur within the current cycle was vastly underutilized among both women actively trying to achieve and women who stated that they may become pregnant within the next year.

We did not find any difference in number of method use among younger or older women, suggesting that age, although an important clinical consideration when referring a woman to infertility services, is not a predictive factor in number of fertility methods a woman is using to monitor her cycle for ovulation. This was true for both women actively trying to conceive and for women contemplating pregnancy within the next year. One unexpected finding was that no other factors were significant predictors for number of fertility method use among this group, suggesting that all women who are actively trying to achieve, regardless of demographic or physical characteristics, make decisions about fertility methods based influenced by their current duration of pregnancy attempt.

Our analysis included women who reported that they were contemplating pregnancy, which is a novel approach to understanding fertility-awareness based method usage among women planning, but not actively trying, for pregnancy. It was interesting that among the women who stated they were contemplating pregnancy, that only partnership (married or in a domestic partnership) was significant in predicting the number of fertility methods used. This may suggest that there is more of an openness to the chance of pregnancy, as evidenced by more fertility methods used, among women who are partnered when contemplating future pregnancy.

Clinical Implications

There is an opportunity for clinicians to educate women who are actively seeking conception and women who may be contemplating pregnancy in the near future on fertility-

awareness-based methods before referral to infertility services. The lack of fertility education to support natural conception is a prevalent problem, and our study shows that methods to track fertility were underutilized. It is important to ensure that when clinicians refer a woman to infertility services that the referral is appropriate and high value, thus protecting patients and the system against the high-cost burden and harmful effects of unnecessary, invasive care. For the women in our study who stated that they were contemplating pregnancy, it is worth assessing her primary form of contraception, as this could also influence time to pregnancy.

Research Implications

Future research in this area should focus on understanding what affects women's fertility monitoring behaviors over time in the group of women who stated that they may become pregnant within the next year. It would be interesting to examine longitudinally the influences that affect women's switch from desiring pregnancy in the future to actively intending to become pregnant. Understanding what drives women's pregnancy intentions is an area for future research. Our study identified that duration of time trying was predictive of how many fertility methods were used and future research is needed to identify if there is trend in method use progression. For example, perhaps adding more fertility methods to track ovulation, instead women using a trial-and-error approach until they find the fertility method that fits best for them. There is also an opportunity for future research to consider why fertility-awareness based methods are underutilized, such as which fertility-awareness based methods are discussed during preconception counselling visits or well-women visits and which methods providers feel confident educating women to use. Results from continued research in this area can inform future educational based interventions for increasing fertility-awareness among women actively seeking pregnancy and those contemplating pregnancy.

Strengths and Limitations

Limitations of the study include that the dataset is derived from a survey/questionnaire and does not employ the use of validated and psychometrically sound measures. Although the NHS 3 is a nationally representative sample, it is not generalizable to all persons, such as non-nurses, trying to conceive, as this study's demographic characteristics do not embody the make-up of a North American population of women who are seeking pregnancy. Additionally, nurses' education may influence their knowledge and use of fertility-awareness based methods, affecting generalizability. To understand the real world implications of our findings, it is necessary to replicate this with a non-nurse sample. The cross-sectional design, while useful to gather preliminary data to support future research and experimentation, cannot be used to determine causal relationships. Hence determining causal relationships was not the goal. Furthermore, validity of self-report duration of pregnancy attempt has not been assessed in this population, although there is documentation in the literature of the reproducibility and validity of this outcome (Gaskins, Rich-Edwards, Lawson, et al., 2015; Gaskins, Rich-Edwards, Missmer, et al., 2015, Joffe et al. 1993).

Strengths of this study were use of data obtained on a relatively large sample of women with pregnancy intention (n=3,175). In contrast to many studies which focus solely among women actively trying to conceive or women with history of infertility, our study population included women who stated that they were contemplating future pregnancy. The findings provide new knowledge about the fertility method behaviors of this group of women and can be used to design future research studies that focus on this group's pregnancy planning intentions.

This study has identified that women with pregnancy intention do not frequently used well-established methods to monitor for ovulation, reinforcing the need for educational

interventions by providers. Establishing which fertility methods a woman is using, as well as the duration of her pregnancy attempt, and her potential success with a fertility method could spare women the exorbitant cost, emotional strain, and potential complications of unnecessary infertility referral.

Supplemental Table 1.
Description of fertility awareness-based methods (FABMs)

FABMs	Description
Tracking menstrual cycle length	- The woman subtracts 18 from the total number of days in her shortest cycle and 11 from the total number of days in her longest cycle. - She considers herself fertile within the range of days calculated and updates the calculations monthly.
Basal body temperature monitoring	- Two to three days after ovulation, basal body temperature stays elevated until next menses. - The lowest temperature before the rise signals ovulation.
Cervical mucus monitoring	- The woman checks vaginal sensation and presence of mucus each time she uses the bathroom. - Last day of slippery or stretchy cervical mucus and/or wet sensation signals ovulation.
Ovulation prediction kits	- The woman voids on a test stick, like those provided by Clearblue® EASY Ovulation. - The test stick detects if the woman had a luteinizing hormone surge, by using a symbol, such as a dark line or a smiley face.
Fertility monitors that use urine samples	- The woman voids on a test stick which she then places into a monitor, like Clearblue® Monitor. - The three possible results are low, high, and peak. Peak is when the LH surge is detected.
Fertility monitors that use saliva samples	- Woman places an oral sensor, such as the OvaCue® monitor, under her tongue daily which records a reading of the electrolyte resistance in her saliva. - The woman's fertility calendar on the monitor will show varying shades of blue (from light to dark) indicating low to peak fertility.
Saliva "ferning" microscopes	- Woman places a drop of saliva from under her tongue onto a microscope lens, such as Fertile-Focus or Ovulens. - If she is ovulating or about to ovulate, she will see a distinct "ferning" crystal-like pattern.

Supplemental Figure 1.
Flow diagram of selection of participants
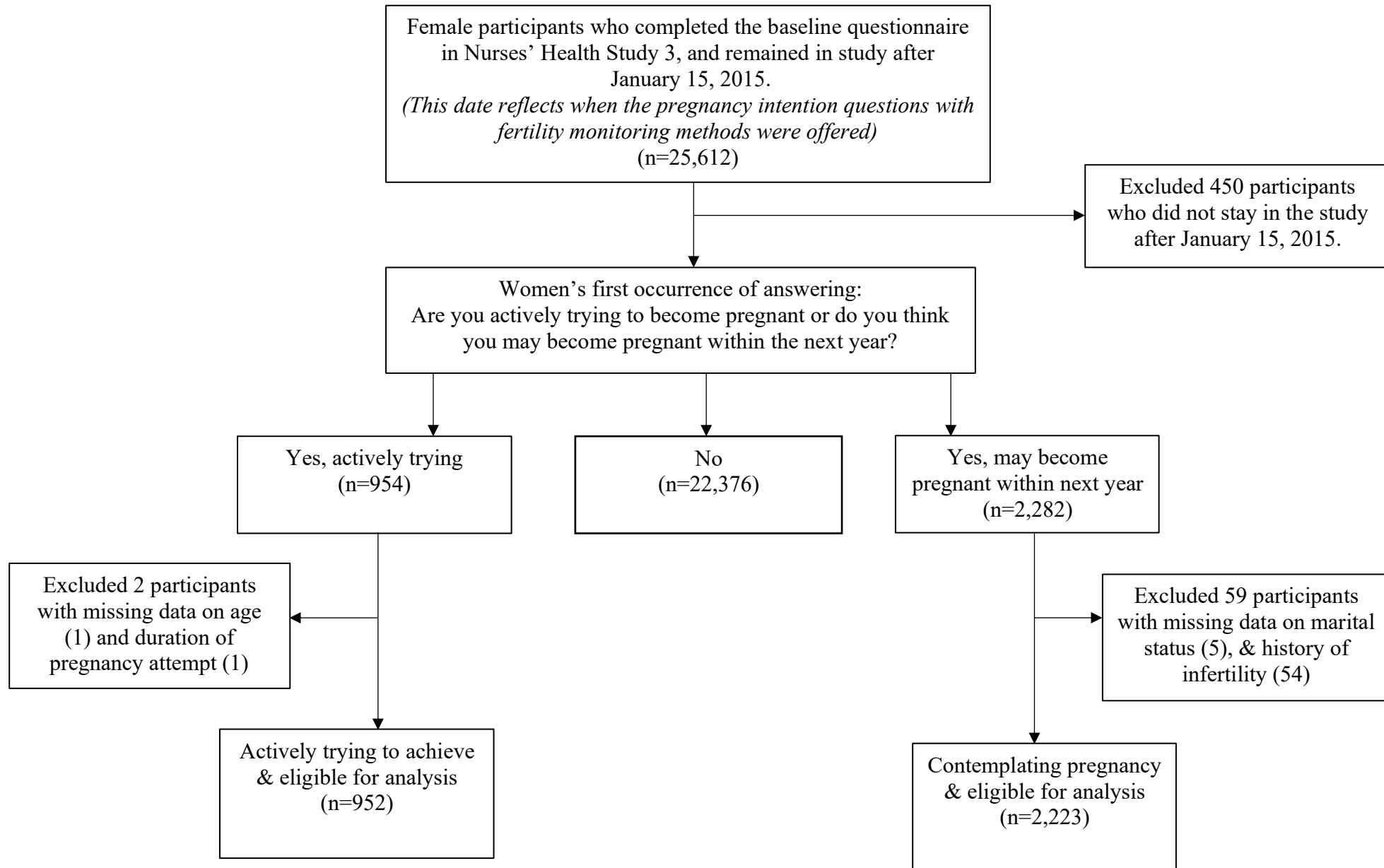
Table 1. Characteristics of the Sample	Actively Trying N=952		Contemplating Pregnancy N=2,223		*p*
	M (SD) or n	%	M (SD) or n	%	
Demographics					
Age, years	30.3 ± 4.5		29.3 ± 4.3		<0.001
Ethnicity					
Not Hispanic or Latina	906	95.2	2,120	95.4	
Not reported	3	0.3	4	0.2	0.931
Race					
American Indian or Alaska Native	6	0.6	6	0.3	
White	874	91.8	2,032	91.4	
Black or African American	16	1.6	56	2.5	
Asian	33	3.5	78	3.5	
Native Hawaiian or other Pacific Islander	7	0.7	12	0.5	
Middle Eastern or North African	3	0.3	5	0.2	
Other	9	0.9	16	0.7	
Not reported	4	0.4	18	0.8	0.491
Marital Status					
Married or Domestic Partnership	584	61.3	1,147	51.6	<0.001
Region					
Northeast, USA	194	20.4	561	25.2	
Midwest, USA	272	28.6	596	26.8	
South, USA	222	23.3	456	20.5	
West, USA	214	22.5	490	22.0	
Canada	39	4.1	69	3.1	
Not reported	11	1.2	51	2.3	0.007
Education					
Diploma in Nursing	2	0.2	5	0.2	
Associate's Degree	36	3.7	89	4.0	
Bachelor's Degree	564	59.2	1,338	60.2	
Master's Degree	183	19.2	418	18.8	

Doctorate Degree	17	1.8	22	1.0	
Not reported	150	15.8	351	15.8	0.450
Employed Outside the Home					
Yes	885	93.0	2,048	92.1	
Not reported	18	1.9	41	1.8	0.330
Physical Characteristics					
BMI, kg/m²	25.99 ± 6.66		25.5 ± 5.94		0.041
Current Smoker					
Yes	6	0.63	5	0.2	0.075
Self-Reported Chronic Health Conditions					
Anxiety	27	2.8	64	2.9	0.947
Depression	281	29.5	591	26.6	0.090
Uterine Fibroids	30	3.2	52	2.3	0.186
Endometriosis	44	4.6	53	2.4	0.001
Grave's Disease	7	0.7	12	0.5	0.513
Hypothyroidism	29	3.1	40	1.8	0.027
High blood pressure	53	5.6	97	4.4	0.143
Elevated cholesterol	118	12.4	238	10.7	0.167
Diabetes (Type I or Type II)	11	1.2	24	1.0	0.851
PCOS	108	11.8	182	8.3	0.002
PCOS not reported	36	3.8	16	0.7	
Pregnancy History					
Number of pregnancies					
Never been pregnant	657	69.0	1,535	69.0	
History of one pregnancy	174	18.3	378	17.0	
History of two or more pregnancies	108	11.3	278	12.5	
Not reported	13	1.4	32	1.4	0.983
History of infertility	227	23.8	186	8.4	
Not reported	33	3.5	0	0	<0.001
Duration of time trying to conceive	7.45 ± 5.03		Question not available for this group		
1 month or less-2 months	264	27.7			

3-5 months	149	15.7			
6-12 months	229	24.1			
1-3 years	310	32.6			
Actively monitor the cycle for signs of ovulation	672	70.6	790	35.5	<0.001
Not reported	58	6.1	259	11.7	

Note. M=mean, SD=standard deviation. TTC=trying to conceive, BMI=body mass index, PCOS=polycystic ovarian syndrome
Measured with Nurses' Health Study 3 (v1.3, 1.4, 2.1, 2.2, & 2.3)

Table 2.
A Priori **Covariate Testing for Number of Methods**

	Actively Trying (*N*=952)				Contemplating Pregnancy (*N*=2,223)			
	Univariate 95% CI		Multivariate 95% CI		Univariate 95% CI		Multivariate 95% CI	
Age, years	.987	1.008	.989	1.017	1.008	1.035	.992	1.028
Marital status	.921	1.116	.953	1.207	1.167	1.475	1.106	1.456
Education								
Diploma	Referent		Referent		Referent		Referent	
Associates	.407	6.818	.473	8.043	.368	8.782	.347	8.987
Bachelor	.474	7.596	.528	8.602	.384	8.704	.342	8.420
Master	.422	6.804	.472	7.749	.411	9.370	.347	8.640
Doctorate	.480	8.325	.540	9.658	.343	9.640	.306	9.379
Employment	.809	1.237	.775	1.276	.820	1.337	.792	1.413
BMI, kg/m^2	.988	1.002	.985	1.004	.993	1.012	.985	1.009
Smoking	.857	1.300	.814	1.299	.399	1.318	.367	1.260
Anxiety	.830	1.427	.807	1.494	.844	1.638	.835	1695
Depression	.871	1.071	.833	1.064	.917	1.188	.800	1.080
Uterine Fibroids	.728	1.258	.650	1.220	.969	1.949	.814	1.810
Endometriosis	.765	1.205	.773	1.343	.691	1.454	.548	1.362
Grave's Disease	.362	1.340	.362	1.357	.151	1.308	.129	1.118
Hypothyroidism	.738	1.281	.715	1.340	.773	1.780	.684	1.661
High Blood Pressure	.856	1.277	.884	1.411	.802	1.404	.703	1.356
Elevated Cholesterol	.855	1.137	.889	1.242	.853	1.240	.913	1.376
Diabetes	.595	1.470	.697	1.781	.723	2.078	.528	1.785
PCOS	.770	1.047	.744	1.092	.895	1.354	.749	1.238
Number of pregnancies								
Never been pregnant	Referent		Referent		Referent		Referent	
History of one pregnancy	.807	1.038	.807	1.082	.966	1.316	.868	1.241

History of two pregnancies or more	.760	1.023	.727	1.054	.986	1.374	.888	1.349
History of Infertility	.926	1.153	.860	1.161	1.128	1.659	1.016	1.620
Duration of time trying to conceive					Variable not offered to this group		Variable not offered to this group	
1 month or less-2 months	Referent		Referent					
3-5 months	1.110	1.511	1.077	1.520				
6-12 months	1.258	1.646	1.252	1.701				
1-3 years	1.204	1.554	1.178	1.613				

Note. CI= confidence interval, BMI= body mass index, PCOS= polycystic ovarian syndrome

Measured with Nurses' Health Study 3 (v1.3, 1.4, 2.1, 2.2, & 2.3)

Table 3. Predictors for Number of Fertility Methods		
Actively Trying (*N*=952)	**IRR**	**95% CI**
Age [a]	.994	.984 1.005
Trying for 1 month or less- 2 months (*n*=264)	Referent	Referent
Trying for 3-5 months (*n*=149)	1.301	1.115 1.518
Trying for 6-12 months (*n*=229)	1.442	1.261 1.650
Trying for 1-3 years (*n*=310)	1.383	1.215 1.574
Contemplating Pregnancy (*N*=2,223)	**IRR**	**95% CI**
Age	1.011	.997 1.025
Marital Status	1.263	1.120 1.424
Grave's Disease	.385	.131 1.130
History of Infertility	1.225	1.001 1.499

Note. IRR= IRR= incidence rate ratio, CI= confidence interval

[a] Age not significant in *a priori* covariate testing, but included in the model because of clinical significance.

*Measured with Nurses' Health Study 3 (v1.3, 1.4, 2.1, 2.2, & 2.3)

	Actively Trying (*N*=952)				Contemplating Pregnancy (*N*=2,223)			
Supplemental Table 2. *A Priori* Covariate Testing for Use of Any FABM	Univariate 95% CI		Multivariate 95% CI		Univariate 95% CI		Multivariate 95% CI	
Age, years	.948	1.022	.951	1.059	1.012	1.052	.992	1.046
Marital status	.672	1.356	.865	2.100	1.260	1.765	1.102	1.640
Education								
Diploma	Referent		Referent		Referent		Referent	
Associates	.170	53.051	.281	103.708	.292	25.313	.211	24.458
Bachelor	.344	89.708	.492	145.348	.332	26.713	.226	24.377
Master	.277	74.547	.398	123.505	.384	31.256	.238	26.053
Doctorate	.325	173.283	.450	291.035	.264	29.046	.168	25.057
Employment	.541	2.398	.359	2.616	.701	1.417	.642	1.479
BMI, kg/m^2	.956	1.003	.966	1.033	.988	1.016	.974	1.008
Smoking	.461	2.782	.327	2.807	.407	1.501	.337	1.385
Anxiety	.599	10.899	.593	12.467	.734	1.985	.707	2.143
Depression	.561	1.161	.436	1.044	.913	1.333	.776	1.201
Uterine Fibroids	.320	1.980	.220	1.677	.867	2.613	.677	2.377
Endometriosis	.362	1.634	.600	7.614	.479	1.457	.318	1.206
Grave's Disease	.096	2.590	.076	2.392	.191	2.123	.145	1.690
Hypothyroidism	.361	2.558	.372	3.968	.558	1.962	.477	1.884
High Blood Pressure	.674	3.819	.980	11.949	.772	1.744	.542	1.463
Elevated Cholesterol	.551	1.517	.627	2.315	.816	1.401	.877	1.626
Diabetes	.139	2.017	.114	3.112	.483	2.426	.302	1.888
PCOS	.252	.624	.224	.745	.798	1.467	.635	1.337
Number of pregnancies								
Never been pregnant	Referent		Referent		Referent		Referent	
History of one pregnancy	.451	1.073	.450	1.346	1.061	1.667	.925	1.566

|							
History of two pregnancies or more	.322	.817	.274	.956	1.153	1.881	.981	1.847
History of Infertility	.496.	1.068	.446	1.414	1.114	2.034	.977	2.036
Duration of time trying to conceive					Variable not offered to this group		Variable not offered to this group	
1 month or less- 2 months	Referent		Referent					
3-5 months	1.017	3.025	.762	2.519				
6-12 months	1.141	2.961	1.079	3.345				
1-3 years	1.030	2.397	.999	3.094				

Note. CI= confidence interval, BMI= body mass index, PCOS= polycystic ovarian syndrome

Measured with Nurses' Health Study 3 (v1.3, 1.4, 2.1, 2.2, & 2.3)

| Supplemental Table 3. Predictors for Use of any FABM			
Actively Trying (*N=952*)	**OR**	**95% CI**	
Age, years [a]	.998	.956	1.040
Trying for 1 month or less- 2 months (*n=264*)		Referent	
Trying for 3-5 months (*n=149*)	1.823	1.045	3.183
Trying for 6-12 months (*n=229*)	1.971	1.121	3.209
Trying for 1-3 years (*n=310*)	1.760	1.128	2.744
Never been pregnant		Referent	
History of one pregnancy	.671	.427	1.054
History of two or more pregnancies	.465	.280	.770
PCOS	.350	.219	.559
Anxiety	3.171	.721	13.946
Depression	.801	1.454	17.345
Contemplating Pregnancy (*N=2,223*)	**OR**	**95% CI**	
Age, years	1.013	.992	1.035
Marital Status	1.359	1.138	1.625
History of Infertility	1.228	.894	1.689
Never been pregnant		Referent	
History of one pregnancy	1.183	.936	1.497
History of two or more pregnancies	1.264	.973	1.643
Endometriosis	.802	.456	1.411

Note. OR= odds ratio, CI= confidence interval, PCOS= polycystic ovarian syndrome

[a] Age not significant in *a priori* covariate testing, but included in the model because of clinical significance.
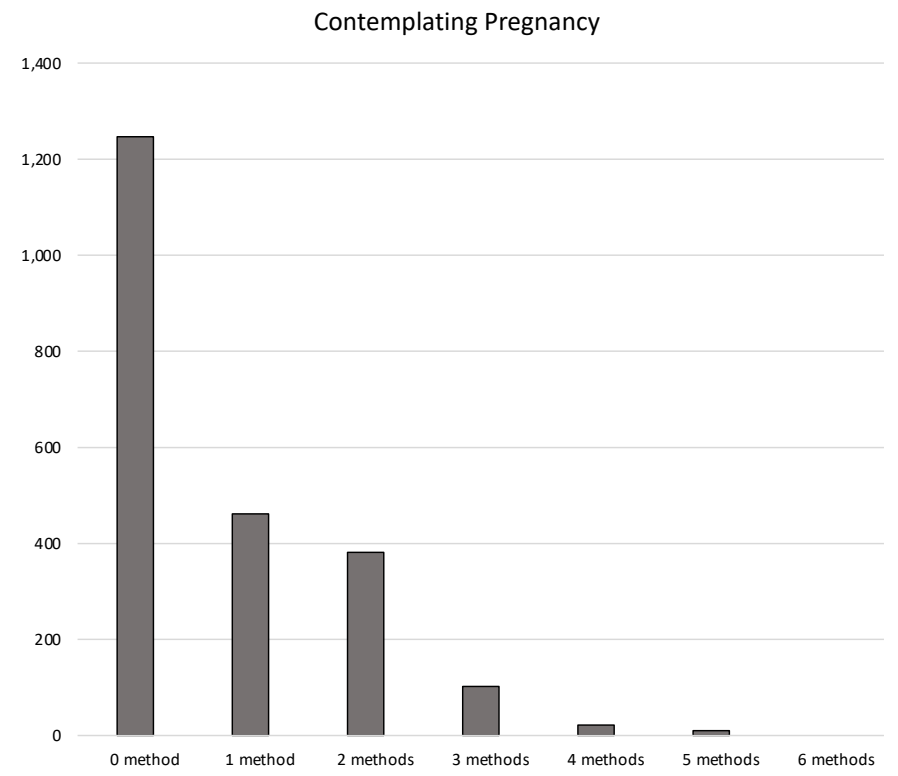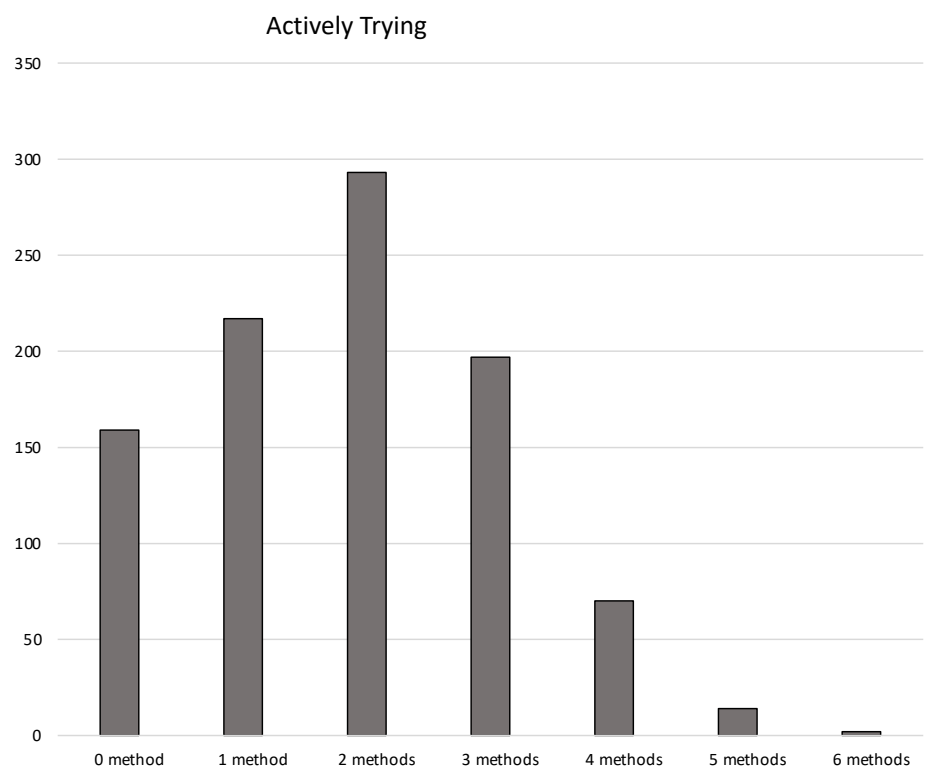
Measured with Nurses' Health Study 3 (v1.3, 1.4, 2.1, 2.2, & 2.3)

Figure 1. Fertility Method Use by Group
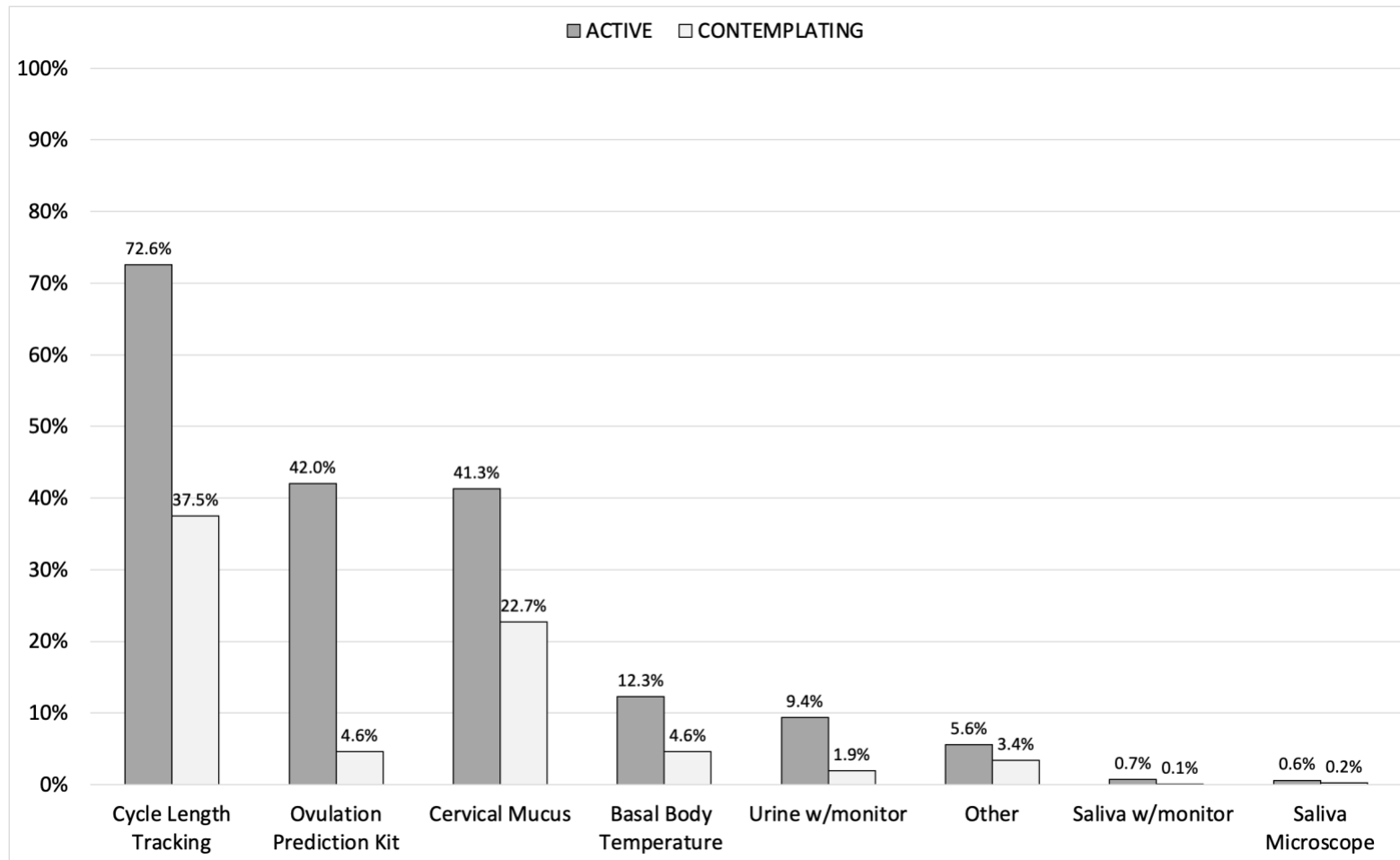
Figure 2. Fertility Method Use by Duration of Time Trying to Conceive in "Actively Trying" Group
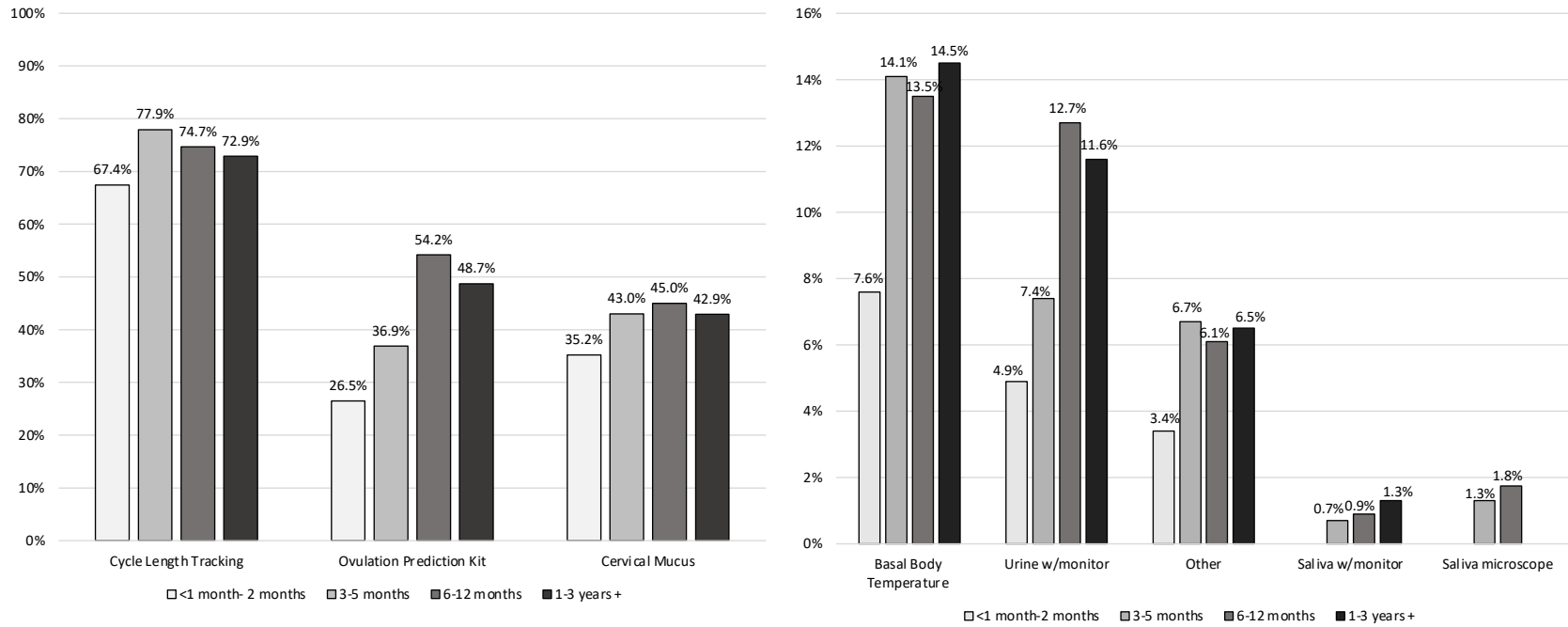
Supplemental Figure 2. Number of Fertility Methods Used

Chapter V

A Qualitative Case Study of Women's Experiences with Fertility-Awareness

Based Methods to Achieve Pregnancy

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This manuscript represents a significant contribution to the Dissertation work.

Target Journal: *The Journal of Perinatal Education*, impact factor: 0.00 *The Journal of Perinatal Education (JPE)* is the official journal of Lamaze International, whose mission is to promote, support, and protect natural, safe, and healthy birth through education and advocacy. Manuscript ready for submission at time of dissertation defense.

Précis statement: Through the journey of trying to conceive, women face many challenges in experimenting with multiple fertility-awareness based methods before finding an effective method. There is a need for healthcare provider's guidance.

Abstract (structured)

Objective: The purpose of this qualitative case study was to ascertain and understand women's experiences using fertility-awareness based methods to naturally achieve pregnancy.

Design: A cross-sectional and qualitative design.

Setting: Individual face-to-face virtual interviews.

Participants: Two women of childbearing age who had a history of using at least one fertility-awareness based method or natural family planning method to conceive a pregnancy.

Methods: A qualitative case study was conducted using narrative interviewing method. Data were collected by face-to-face virtual interviews. Data analysis were conducted within and across the cases to identify the essential themes. The results of the case study were presented using a roster derived from the literature.

Results: Five essential themes were emerged from the rich data to illuminate the women's stories of using fertility-awareness based methods to achieve pregnancy. The essential themes included: (1) having a sense of control; (2) experimenting with different methods; (3) overcoming self-doubt; (4) enduring pressure; and (5) lack of guidance from healthcare providers.

Conclusion: This qualitative case study was able to elicit rich data enabling a description of how women went through the journey of achieving pregnancy using fertility-awareness based methods. Findings underscore that women preferred using natural ways to detect ovulation and would recommend other women to do so, but with healthcare providers' guidance. Findings of

this case study can serve as a starting point to provide a framework to understand women's experiences of enduring trial and error with multiple fertility-awareness based methods before discovering their effective method. Findings emphasize the importance for healthcare providers to guide women in using fertility-awareness based methods.

Abstract (summary)

Fertility-awareness based methods can be used to enhance the likelihood for women seeking pregnancy to conceive through women's identification of ovulation. However, existing literature has found that knowledge regarding fertility among women trying to conceive is low, and fertility-awareness based methods are underutilized. This qualitative case study was conducted to ascertain women's experiences using fertility awareness based methods to naturally achieve pregnancy. The essential themes that were emerged included: (1) having a sense of control; (2) experimenting with different methods; (3) overcoming self-doubt; (4) enduring pressure; and (5) lack of guidance from healthcare providers. Important clinical and research implications can be drawn from the findings.

Keywords: fertility-awareness based methods, natural family planning, trying to conceive, women's health, pregnancy, preconception, fertility

Quick Points:

- The activity of fertility tracking and charting provided the women a sense of self-efficacy as well as a confidence in one's own body.

- The women emphasized a lack of support from healthcare providers regarding natural methods to conceive.

- It is important to meet the needs of women in their journey to achieve pregnancy, especially knowledge about FABMs and ways to effectively mitigate the stress.

INTRODUCTION

A woman and her partner's journey to achieve a desired pregnancy is unique, multifaceted, and often complex. This complexity is amplified when fertility problems are present during her journey to conceive. Fertility issues are common and affect substantial numbers of women in the United States. The Center for Disease Control and Prevention (CDC) reported in 2019 that 12.1% of women aged 15-44 years in the United States have difficulty getting pregnant or carrying a pregnancy to term (CDC, 2020). Fertility-awareness based methods (FABMs) can be used to enhance the likelihood for women to conceive. Several evidenced-based fertility-awareness based methods (FABMs) allow women to predict ovulation and estimate peak fertility. These include cervical mucus methods, basal body temperature, detection of urinary or salivary luteinizing and estradiol hormone, and calendar methods. Successful use of FABMs depends on accurate instructions that women can follow, correct and consistent charting, and the woman's adherence to the principles of her chosen method. However, the literature has identified low levels of knowledge regarding the menstrual cycle, ovulation, and the fertile window among infertile women and women seeking pregnancy (Blake et al., 1997; Hampton et al., 2013; Mahey et al., 2018; Righarts et al., 2017). Consequently, if women are unable to identify the time in their cycle when conception is most likely (fertile window) then they may be referred to assisted reproductive technology (ART) unnecessarily. Examples of ART include in vitro fertilization, intra–uterine insemination, gamete intrafallopian transfer, pronuclear stage tubal transfer, tubal embryo transfer, and zygote intrafallopian transfer. It is problematic that women may be referred to ART before efficacious, natural, and simpler interventions are explored, especially considering that ART services are not without significant health risks and cost. Little is known

about women's journey of using FABMs to achieve pregnancy. It is essential that healthcare

providers understand women's experiences and perception of using a

variety of FABMs to achieve pregnancy during this special and important period of time for

women and their partners.

Purpose of the Case Study

The purpose of this qualitative case study was to ascertain and understand women's experiences

using fertility-awareness based methods to naturally achieve pregnancy.

METHODS

Ethical consideration

This study was exempted by the Boston College institutional review board. Informed consent

was obtained from all participants.

Design

A cross-sectional and qualitative design with narrative interviewing method was employed to link

the experiences of the women "in time and in meaning" (Anderson & Kirkpatrick, 2016; Good

MJDV, 1994; Good MJDV, 1995; Qiu & DelVecchio Good, 2020). The narrative interviewing

method was used because humans by nature make sense of their lives through stories (Anderson

& Kirkpatrick, 2016). A woman's story using FABMs to achieve pregnancy has a temporal

context. The woman is the main character and her supporting characters may include a spouse,

family members, friends, or healthcare providers. As such, the use of the narrative interviewing

method is the optimal way to understand the intricacy in women's experiences and perceptions

through their personal stories (Anderson & Kirkpatrick, 2016; Good MJDV, 1994; Good MJDV,

1995; Qiu & DelVecchio Good, 2020).

Sample and Setting

A purposive sample of two women who exemplified the experience of FABMs to achieve

pregnancy was recruited for this qualitative case study. Potential eligible women were invited

through a study invitation which briefly described the purpose of the study. Interested potential

participants contacted the first author and women who met the inclusion criteria were recruited.

The inclusion criteria were: (1) female between age 21 to 44 years old; (2) had a history of using

at least one fertility-awareness based method or natural family planning method to conceive a

pregnancy without the use of any assisted reproductive technology, such as in vitro fertilization

or intrauterine insemination.

Data collection

Data were collected using semi-structured interviews in which the first author began the

interview with an open ended question to allow the women to control the direction and content of

the their stories.[6] An interview topic guide was developed to elicit data on topics of interest. The

first author conducted individual face-to-face virtual interviews with the participants via Zoom

Version 5.3.1 in November 2020. The interview began with the open ended question: "Please tell

me the story of how you and your partner came to the decision to start a family." Probes (e.g.,

"Please tell me more about that…") and questions related to topics of interests were used to

encourage more detailed information. The interviews lasted about 40 minutes and were

transcribed professionally.

Data analysis

An iterative and inductive thematic data analysis method was used to analyze the narrative data

with attention in maintaining the temporal elements within the women's stories (Fu et al., 2008;

Fu & Rosedale, 2009; Qiu & DelVecchio Good, 2020). Box 1 presents the seven steps of this

iterative data analysis method. Through this data analysis procedure, the meanings and

experiences associated with a women's journey of using a variety of FABMs to achieve pregnancy were intuited into essential themes to interpret the women's experiences (Anderson & Kirkpatrick, 2016; Fu et al., 2008; Fu & Rosedale, 2009; Qiu & DelVecchio Good, 2020).

Rigor and trustworthiness

Rigor of the qualitative case study was ensured in terms of credibility; transferability; dependability; and confirmability (Lincoln & Guba, 1985). Credibility was achieved through reflective journals, field notes, and verbatim transcriptions. Credibility was also assured by the participants' confirmation of the accuracy of transcriptions. Transferability was supported by rich and detailed descriptions from the participants. Evidence for dependability was supported by the emergence of similar data from the two interviews. Confirmability was achieved by inter-rater reliability among researchers.

FINDINGS

Two women in their 30s participated in this qualitative case study. The women had graduate degrees in nursing, were married, and employed. The women had endured a previous pregnancy loss (spontaneous abortion and ruptured ectopic pregnancy) prior to conceiving their first live birth. They had used FABMs for approximately 11-13 months before achieving their first successful pregnancies resulting in live birth. At the time of the case study, both women had healthy children.

The journey to pregnancy began when the women and their partners (husbands) felt that the timing to start a family was right. The women emphasized their appeal for a natural approach to conception with reasons including a desire for the least invasive approach and an overall belief in their body's capabilities. The narratives ended with the women describing the happy moment when she had found out she had successfully conceived. Five essential themes emerged from the

data that illuminated the description of the women's stories of using FABMs to achieve

pregnancy: (1) having a sense of control; (2) experimenting with different methods; (3)

overcoming self-doubt; (4) enduring pressure; and (5) lack of guidance from healthcare providers.

Table 1 provides additional supporting quotes for the five essential themes.

Having a sense of control

The process of learning to track the menstrual cycle and how to identify ovulatory signs offered

the women a sense of control. The activity of tracking and charting provided a sense of self-

efficacy as well as a confidence in one's own body. The women were not passive participants in

their journeys to conceive, but rather were dynamically involved in their daily tracking practices,

and with that, gained reassurance.

> *"You know rather than just feeling like months were going by and I wasn't getting pregnant, I think I felt like that I had more a sense of why that might be. Like maybe I didn't ovulate that month. Or you know, that we didn't have intercourse at the right time. And so I feel like it, it helped me understand what was happening with my body more." (Participant 1).*

Experimenting with different methods

For the women, the journey to finding the method that ultimately allowed them to detect

ovulation and conceive was a journey of trial and error through testing multiple fertility-awareness

methods. The women eventually came to the decision to use the ovulation predictor urinary

luteinizing hormone (LH) strips after 6 months of trialing cervical mucus, timed coitus, and

fertility tracking apps. Of note, participants were also prescribed either Metformin or

Levothyroxine by their health care providers for cycle irregularity, but did not use medications

for ovulation stimulation such as Clomiphene or Letrozole. Table 2 provides a list of methods

that women may use to track fertility in a sequential and progressive way that the participants in

the study trialed each method.

> *"I started tracking my periods. I have PCOS (polycystic ovarian syndrome) so my periods are very irregular. The bleeding is very irregular. We started... I feel like tracking, just tracking my periods, probably in May. At the time, I feel like my cycles were between 35 and 45 days. I was using cervical mucus to predict ovulation at that point. And then we were timing coitus every other day and nothing was happening. So I gave that 3 months. Yea, so in August, I started being more pro-active in it. So I was very meticulous about checking my cervical mucus every single day. I started seeing an acupuncturist. I also started Metformin. And so when I started Metformin, I also added Vitex. And then in November when we still weren't pregnant I was like, "This is exhausting". And so I bought the LH strips." (Participant 2)*

Overcoming self-doubt

Although the process of learning how to track their fertility allowed for a sense of control, there

were also periods of uncertainty. When conception was not achieved after a few months of using

a particular method, the women began to question their ability using the method as well as the

method itself. In overcoming this self-doubt, each woman sought a method to alleviate some of

the uncertainty, and both women found that with the detection of luteinizing hormone (LH) using

urinary strips.

> *"Even though I felt like I was kind of sure, I was like I might as well, you know, like a few days after I end my cycle, just to see what was happening (use the strips). And so LH typically surges in the afternoon so I was using that, so I was testing um every afternoon starting probably day 10 of my cycle to see But I felt very confident in those strips, I guess. I felt more confident in the strips than I did um with checking my cervical mucus probably because it was quantifiable I guess." (Participant 2)*

Enduring pressure

The women recalled experiences of feeling pressure from either husband, friends, family, or self.

Although they kept their fertility tracking for the purposes of achieving relatively private, the

women sensed internal and external pressure during their journey to pregnancy. Questions and

comments related to when her and her husband would start a family, or why she was not

pursuing assisted reproductive technology, were described by the women as obnoxious and

intrusive when asked by family members or friends, "when are you going to have a kid?" The

women had to overcome a sense of judgment and pressure from the people close to them at times.

> *"I also think like towards the end of the year before I got pregnant like I was starting to get kind of depressed about it. Like 'Why? Why aren't I getting pregnant?' And again like everybody around me getting pregnant and I remember being very hard." (Participant 1)*

Lack of guidance from healthcare providers

Each woman made strong statements regarding the lack of guidance from healthcare providers

regarding natural methods. The women felt that they were on their own in their journey of

choosing fertility methods and that healthcare providers did not provide guidance on how to use

natural methods. The women stated that they got more of a sense that they would be referred to

a fertility specialist instead of counselled on what to look for regarding their chosen fertility-awareness based methods. The women both felt as if there is more discussion and knowledge regarding assisted reproductive technology, such as in vitro fertilization, than there is about natural ways to conceive.

> *"It did very much feel like I was on my own. Like this wasn't something that was endorsed by my medical providers to really give me guidance or to say "Well maybe, you know, you want to look for this" or "Maybe you want change this time where you using the kits". There wasn't any guidance on that. I can't say I really sought it out. But there wasn't a sense. The sense I got when I had gone for my visit was that, you know was, we can send you to someone else. It wasn't sort of a discussion of like what I could do on my own." (Participant 1)*

DISCUSSION

The process of achieving a pregnancy is often endured by women and their partners privately. This qualitative case study used the narrative interview approach that enabled the development of an overarching timeline of decision-making on fertility and FABM methods, and gained insights into the process of fertility tracking and use of a variety of FABMs from the women's perspective. Findings support the use of narrative interviewing method via face-to-face virtual interview as a research and clinical tool. The five essential themes are a starting point to provide a framework to understand women's experience of going through trial and error with multiple FABM methods and their endurance of internal and external pressure during the journey of achieving pregnancy.

The essential themes of experimenting with different FABM methods and lack of guidance from healthcare providers have a particular importance for clinical practice. Our participants identified that there is an important need for healthcare providers' guidance on using FABMs. It is important to meet the needs of women in their journey to achieve pregnancy, especially knowledge about different FABM methods and ways to effectively cope with internal and external pressure. Future research is warranted to elucidate the optimal time when women

should receive this education, the type of visit (routine annual exam or pre-conception counseling visit) and how to delivery fertility-awareness education.

It is important to note that the process of progressively experimenting multiple methods to discover the effective method elicited self-doubting and stress for the women. It is worth exploring if a relationship exists between duration of months trying and FABMs used. Education regarding evidenced-based FABMs methods could improve conception rates and potentially decrease unwarranted and expensive referrals to ART. Such education may also mitigate stress and improve emotional well-being in women during this special time.

The interview topic guide elicited focused and rich data needed to answer this important clinical and research question; it can be used for healthcare providers to initiate the conversations with women regarding natural methods to conceive (Table 3). The method of face-to-face virtual interview was able to engage the women. This is very important in providing alternative research and clinical care giving situations like Covid-19.

CONCLUSION

This qualitative case study was able to elicit rich data enabling a description of how women went through the journey of achieving pregnancy using fertility-awareness based methods. Findings underscore that women preferred using natural ways to detect ovulation but need professional guidance. The essential themes emerged from this qualitative case study can serve as a starting point to a framework to understand women's experiences of enduring trial and error with multiple fertility-awareness based methods before discovering their effective method (Lowe, 2019). Findings emphasize the importance for healthcare providers to guide women in using fertility-awareness based methods.

Box 1. An iterative and inductive thematic data analysis method

(1)   Interview transcripts were read multiple times to gain a broad understanding of the data;
(2)   Important statements from the transcripts were identified related to the phenomenon;
(3)   Quotations that expressed similar meanings were categorized and meaning was given to those quotations;
(4)   Steps 1-3 were repeated to determine essential themes;
(5)   An exhaustive list and description of themes and quotations were compiled;
(6)   Transcripts were reviewed again with descriptions obtained in Step 5 to validate themes;
(7)   Discussion with expert qualitative researcher (i.e., the second author), to achieve consensus and confirm credibility. Authors independently reviewed all transcripts and coded the data collaboratively.

Table 1. Essential Themes and Supporting Quotes

Having a Sense of Control	"I think I was fairly against using artificial technology. I'm Catholic but I don't know if it was necessarily a religious reason. I think it was more of a just a self-efficacy thing. Of like, 'I can do this. My body can do it. I got pregnant once before. And I'm young. And my mom my mom is 1 of 12. So I believe that there are fertile people around me. So again, I was sort of steadfast in my method." (Participant 1)	"Ok, so the cervical mucus was... I wanted to start least invasive. And I knew that there was no way that I would be able to do the basal body temp at the exact same time every single morning. So I chose to do my cervical, to check my cervical mucus. I'm comfortable with my body and have no issues or qualms with checking my cervical mucus every day." (Participant 2)
Experimenting with Different Methods	"My cycles were also fairly irregular during that time so I was struggling with when I might be ovulating and if we were timing things correctly. And so I started using like assessment of the cervical mucus. And trying to see like if it was sticky, if you could pull it apart. And also trying to kind of sense in my body like when I would feel maybe some ovulation type symptoms... like I don't know like cramping in my lower quadrant and having a sense that like maybe it would be, you know, 10 or 15 days after my last period so sort of timing it on a calendar. And I did that for about 3 more cycles, so 3 more months. And still then it was like 6 months and we still weren't pregnant. And then at the time also other people around me were starting to get pregnant. And so I was feeling like, wow I have to really kick this into gear! (laugh) So I started using a fertility tracker app on my phone. I don't actually remember which one, and this was about 5, no, 7 years ago. So I don't even know if it's the same one. And then I started using the ovulation sticks." (Participant 1)	"I decided to get the LH strips, because even though I felt like my cervical mucus was changing, it felt like it wasn't changing enough." (Participant 2)

Overcoming self-doubt	"Like you know that you're trying to conceive in your fertile window and you're not. And just sort of a sense that like 'What was I doing wrong?' And I felt like I was tracking all the right things but maybe there were something wrong with my body?" (Participant 1)	"Like I felt like I was pretty sure in the beginning of when I was monitoring it and then after a little bit of time, I was like, "Oh is this, is this it? Is it egg white? Is it?" You know and I just kind of went back and forth." (Participant 2)
Enduring Pressure	"So it was mostly some medical providers and then like people in my family that knew I had the miscarriage saying like, 'What's, what's holding you up? Why aren't you getting pregnant again?' So not sort of pushing me to seek help but more like more pressure around what's taking her so long or did they change their minds. And just people being kind of nosy." (Participant 1)	"I guess there have been some, some family and friend pressures of 'Ok, when are you going to have a kid? Come on, you've been married for how many years? Like come on, when is it going to happen?' Which is really obnoxious. But I chose to not take it to heart. Because it's just a choice that I feel like I have to consciously make. To thrive. And survive." (Participant 2)
Lack of Guidance from Healthcare Providers	"I remember when I was seeing my provider, like after trying for a little while, and they checked my thyroid. I remember them not asking me what I had been doing to try to conceive. And I remember them just saying they could just send me to somebody and me being frustrated. Like, 'You haven't even asked what I have been doing.' And I felt like, again, like that sense that I know my body pretty well and like nobody... there was just a knee-jerk reaction for me to see somebody instead of like trying to bolster ways that I could track my cycle or things I didn't know about or and not necessary a support for the natural approach. I felt a little pressure to like take the next step. And when I asked like, 'Why would you have me see somebody?' They were like, 'Well because you seem worried about it. Because you seem concerned'. And I'm like, 'Well I am but I'm not I don't want to do that yet."(Participant 1)	"I feel like there is a lot more, well there is more money in IVF and IUI then there is in teaching people how to take of their own bodies." (Participant 2)

Table 2. Experimenting with Different Methods

Ways to Detect Fertile Window		Participant Use	Resources to Learn Method
Cervical Fluid	Last day of slippery or stretchy cervical mucus and/or wet sensation signals ovulation. Adequate instruction from a trained instructor with follow up is optimal.	Yes, but without trained instruction from family planning teacher	TwoDay Method® Billings Ovulation Method ® Creighton Model FertilityCare™ System
Basal Body Temperature (BBT)	Two to three days after ovulation, basal body temperature stays elevated until next menses. The lowest temperature before the rise signals ovulation.	No	Basal Body Thermometers available at most pharmacies over the counter. Charts to track temperatures free online.
Symptothermal	Combination of cervical mucus, BBT, and a cervical check. At ovulation, the cervix will rise, soften, and opening will become wide.	No	Couple-to-Couple League SymptoPro Justisse Taking Charge of Your Fertility
Symptohormonal	Fertility monitor or urinary test strips to measure the presence of urinary metabolites (luteinizing hormone and estradiol) to detect high and peak fertile days.	Yes	Marquette Model Premom FEMM™

*Note any fertility apps that participants used to track cycle days are not included in this table. There are many fertility apps on the market that use a number of different algorithms to either predict the fertile window or simply allow the woman to keep track of her cycle. Participants could either not recall the specific apps that was used and/or the apps have changed since used.

Table 3. Topic guide for narrative interviews

Opening Questions
• Please tell me the story of how you and your partner came to the decision to start a family.
Focused Interview Questions
• I would like to know more about what influenced you in the process of selecting your fertility tracking method. Please give some examples of people and situations that might have influenced your decision to use the FABM of your choice.
• Please tell me at which point and how you arrived at the decision to track your cycle using... (her chosen FABM).
• Please share with me your experience using your chosen FABM.
• Given what your family looks like now, if you had the option of doing it all again, please describe whether you would pursue the same FABM to track fertility.
• If a woman was hoping to achieve a pregnancy, trying to decide if (her method of FABM) is the right method for her, what piece of advice would you give her?
• Do you have anything that you want to share that I have not asked you?

Chapter VI

Discussion

The overall purpose of this program of research is to examine fertility-awareness based method (FABMs) use among women seeking pregnancy. A variety of data sources and methods were used in a stepwise manner to collectively form a single, cohesive body of work that: 1) synthesized the literature regarding fertility knowledge and fertility-awareness practices, 2) identified if factors were predictive for a women's decision to use a FABM, 3) evaluated the association of duration of pregnancy attempt on FABM use, and 4) described women's experiences using FABMs to achieve pregnancy. The final section of the dissertation will present the primary research findings from each of the four manuscripts within the context of existing literature; summarize the overall strengths and limitations of the work; and discuss how the research as a whole advances the sciences in terms of implications for theory, clinical practice, and future research.

<div align="center">Discussion</div>

In order to address the overall goal of the program of research, four specific aims and associated manuscripts were proposed. Table 1 presents the major findings from each study by specific aim. Following the table, major findings will be elaborated on by aim. In particular, this discussion will focus on findings pertinent to 1) fertility knowledge, 2) FABM(s) utilization and predictors of FABM(s) use, 3) the relationship between duration of current pregnancy attempt and FABM use, and 4) women's experiences with FABMs.

Table 1. Major Findings by Specific Aims

Aim	Findings
Aim 1: Synthesize the literature regarding fertility knowledge and fertility awareness practices among women who seek pregnancy	• Participants in studies that identified women's knowledge regarding the menstrual cycle, ovulation, and the fertile window were low, ranging from approximately 12-15% • Small percentages of women, ranging from approximately 4-13%, had accessed a natural family planning clinic or teacher as a source of fertility education • Women sought out a variety of sources for learning about fertility-awareness, with internet being the most sought out followed by non-specialist medical practitioners • There are a number of different instruments to evaluate fertility knowledge; Instruments should evaluate both general fertility knowledge (modifiable and non-modifiable risk factors) as well as fertility-awareness (indicators of ovulation)
Aim 2: Explore the factors that influence women's decision to use FABMs.	• Few women who had sought advice from a healthcare provider about conception had historic use of one of the three FABMs in the survey (27%) • The sample was primarily married (70%), non-Hispanic women age 35 years or older ($M = 37.4$ years, $SD = 7.3$). Most were college educated ($n = 253$, 74.4%), employed ($n = 317$, 74.9%), and had health insurance ($n = 392$, 92.7%). • The most frequently used FABM was calendar rhythm method ($n = 103$, 24.6%) • The most effective FABM for predicting ovulation in the data set, temperature/cervical mucus was used infrequently ($n = 33$, 7.9%)
Aim 3: Evaluate whether duration of current pregnancy attempt is associated with fertility- awareness based method(s) use.	• The three most commonly used fertility- awareness based methods for women actively trying were keeping track of the menstrual cycle ($n=691$, 72.6%,), ovulation predictor kits ($n=400$, 42.0%), and cervical mucus monitoring ($n=393$, 41.3%) • Women who had been actively trying for 6-12 months used on average 30% more fertility methods compared with women who had been trying for 1-5 months (ie, 0.26 ± 0.06 more methods). • Women who had been actively trying for 1-3 years used on average 25% more fertility methods compared with women who had been trying for 1-5 months (ie, 0.21 ± 0.06 more methods). • Duration of ongoing pregnancy attempt was the only significant factor in predicting number of fertility-awareness based methods used among women actively trying to conceive. Although age was retained

	in the model secondary to referral guidelines to infertility based on age and duration of months trying, there were no differences in the number of methods used based on age.
Aim 4: Describe women's experiences with a variety of FABMs to achieve pregnancy	• Five essential themes were emerged from the rich data to illuminate the women's stories of using fertility-awareness based methods to achieve pregnancy. The essential themes included: (1) having a sense of control; (2) experimenting with different methods; (3) overcoming self-doubt; (4) enduring pressure; and (5) lack of guidance from healthcare providers. • The activity of fertility tracking and charting provided the women a sense of self-efficacy as well as a confidence in one's own body. • For the women, the journey to finding the method that ultimately allowed them to detect ovulation and conceive was a journey of trial and error through testing multiple fertility-awareness methods. • The women emphasized a lack of support from healthcare providers regarding natural methods to conceive.

Principle Finding Aim 1: Low Fertility Knowledge

As the first step in the evaluation of fertility-awareness based method use, an integrative review of the literature regarding fertility knowledge and women's attitudes toward FABMs specifically among women seeking pregnancy was done (Chapter II). Nine research studies with cross-sectional designs published between 1997-2020 (n=9) were included. The samples for all of these studies were composed of women attending infertility clinics or women with intention to conceive but not yet receiving fertility services. Researchers either identified women's fertility knowledge related to the menstrual cycle and signs of ovulation or women's general knowledge regarding fertility and fertility risk factors or both. Findings from the review highlighted three things: a) knowledge regarding the time in the cycle in which to conceive was low among the women studied, b) fertility-awareness practices were underutilized by women trying to conceive, and c) women desire fertility education and seek out information from a range of sources. Across studies that aimed to measure knowledge regarding the menstrual cycle, ovulation, and the fertile window, women reported low knowledge ranging from approximately 12-15%. Knowledge regarding the fertile window and ovulation is essential for timing conception. General fertility knowledge regarding fertility and fertility risk factors (e.g., age of fertility decline, history of sexually transmitted infections, smoking, obesity, and use of assisted reproductive technology [ART] terminology) was moderate across studies that measured this outcome. Although general fertility knowledge levels were modest, it is concerning that women who were actively trying to conceive had low knowledge regarding the fertile window. With accurate information and instruction provided to women regarding how to track and identify the fertile window, conception rates could improve, leading to less need for intervention.

Women's attitudes towards FABM ovulation tracking were also examined. Small percentages of women, ranging from approximately 4-13%, had accessed a natural family planning clinic or teacher as a source of fertility education. Of the women who had received natural family planning education, 80% had high fertility awareness secondary to the education received (Blake, 1997). Righarts et al. (2017) noted that fertility monitoring was not only underutilized to conceive a pregnancy (23.3%) but that among those who had monitored ovulation, only 16.8% could recognize the optimal time for conception. Hence, sufficient knowledge regarding fertility must be used in concert with ovulation prediction methods in order for tracking to be successful. Women also sought out a variety of sources for learning about fertility-awareness. Approximately 25-49% of women used Internet sites as a source for fertility-awareness education and 30-33% sought out non-specialist medical practitioners (Hampton et al., 2014; Righarts et al., 2017). If women are accessing unreliable, noncredible sources, that could negatively affect not only their fertility knowledge but also the efficacy of their chosen method. Lastly, there are a number of different instruments to evaluate fertility knowledge. The instruments included in the studies included in this integrative review included the Cardiff Fertility Knowledge Scale (CFKS), the Fert-AP survey, or researchers developed their own questionnaires. More recently developed instruments for assessing fertility knowledge include the Fertility and Infertility Treatment Knowledge Score and the Mu Fertility Knowledge Assessment Scale. However, the application of such instruments outside of research and in clinical practice remains to be seen. Instruments should evaluate both general fertility knowledge (modifiable and non-modifiable risk factors) as well as fertility-awareness (indicators of ovulation).

Principle Finding Aim 2: FABMs Under-Utilized Among Women Seeking Pregnancy

In order to address the second aim of the dissertation, a secondary analysis of a large national sample of Americans was done (Chapter III). The study used data from the National Survey of Family Growth (NSFG), 2015-2017. The purpose of the secondary analysis was to explore the historic use of fertility-awareness based methods and factors that influence their use among a subset of women who had ever sought advice about becoming pregnant. The sample was primarily married (70%), non-Hispanic women age 35 years or older ($M = 37.4$ years, $SD = 7.3$). Most were college educated ($n = 253$, 74.4%), employed ($n = 317$, 74.9%), and had health insurance ($n = 392$, 92.7%). Key findings of the study showed that few women who had sought advice from a healthcare provider about conception had historic use of one of the three FABMs in the survey (27%). The most frequently used FABM was calendar rhythm method ($n = 103$, 24.6%), which can be difficult for women with irregular menstrual cycles to use as it provides only a rough estimate of the fertile time using calculations from lengths of previous cycles. The most effective FABM for predicting ovulation in the data set, temperature/cervical mucus was used infrequently ($n = 33$, 7.9%). The model containing all predictors was not statistically significant: χ^2 (6, N=423) = 5.686, $p < .459$; this indicates that the model was unable to distinguish differences in predictors between respondents who had or had not used an FABM. The results may indicate that women across ages, marital status, employment, education, insurance status, and religion have equal likelihood of using an FABM.

The results of Chapter IV, which was a secondary analysis using data from the Nurses' Health Study III (2015-2021), validated the results from Chapter III: well established methods of fertility-awareness were underutilized among women trying to conceive and there were no significant demographic predictors for use. The total sample for Chapter IV was primarily white (92.2%), non-Hispanic or Latina (95.5%), women with mean age 29.6 years $\pm$ 4.4. Most were

employed (94.1%) and married or in domestic partnership (54.5%). In Chapter IV, the three most commonly used fertility- awareness based methods for women actively trying were keeping track of the menstrual cycle (n=691, 72.6%,), ovulation predictor kits (n=400, 42.0%), and cervical mucus monitoring (n=393, 41.3%). Similarly to Chapter III, the most frequently used fertility method was keeping track of the menstrual cycle length, which is also referred to as the calendar method. Although the frequency of women who reported a method of fertility tracking were higher in Chapter IV, well established methods were still underutilized. The only significant factor for predicting number of fertility methods used was duration of ongoing pregnancy attempt, which was not a variable in Chapter III, as the sample in Chapter III were not women actively trying. Both studies found no significant demographic or physical characteristics as predictors for FABM utilization. Therefore, FABM counseling may be an appropriate initial intervention across a broad demographic of women seeking advice on achieving pregnancy. Considering the cost, emotional strain, and potential complications of ART, practitioners should consider encouraging women to try an FABM before referring them for ART.

Principle Finding Aim 3: Duration of Pregnancy Attempt Predictive of Number of FABM(s) Used

In order to address the third aim of the dissertation, a secondary analysis of a cohort study of women from the Nurses' Health Study III was conducted. The primary aim of this study was to evaluate whether duration of current pregnancy attempt is associated with fertility-awareness based method use among women actively trying to conceive. A secondary aim was to validate findings from Chapter III, such as explore predictors for the number of fertility-awareness based method (s) among women actively trying to conceive, which has been commented on in "Principle Finding Aim 2". Among participants for this analysis (n=3,175), 952 were actively

trying to conceive and 2,223 reported that they may become pregnant within the next year.

Duration of ongoing pregnancy attempt was a variable that was only offered to the 952 women

who were actively trying to achieve pregnancy. To address the primary aim of the study,

multivariable negative binomial regression was used to test the relationship between duration of

ongoing pregnancy attempt and number of fertility-awareness based methods used. In

multivariable models, women who had been actively trying for 6-12 months used on average

30% more fertility methods compared with women who had been trying for 1-5 months (ie, 0.26

$\pm$ 0.06 more methods). Women who had been actively trying for 1-3 years used on average 25%

more fertility methods compared with women who had been trying for 1-5 months (ie, 0.21

$\pm$0.06 more methods). Duration of ongoing pregnancy attempt was the only significant factor in

predicting number of fertility-awareness based methods used among women actively trying to

conceive. No other factors were significant predictors for number of fertility method use,

suggesting that all women who are actively trying to achieve, regardless of demographic or

physical characteristics, make decisions about fertility methods based influenced by current

duration of pregnancy attempt.

Principle Finding Aim 4: Progressive Experimentation of FABMs and Lack of Provider

Guidance

A primary data collection on a pilot sample (*n*=2) of women who discussed their

experiences using FABMs to achieve pregnancy addressed the fourth aim of the dissertation

(Chapter V). Five essential themes were emerged from the rich data to illuminate the women's

stories of using fertility-awareness based methods to achieve pregnancy. The essential themes

included: (1) having a sense of control; (2) experimenting with different methods; (3)

overcoming self-doubt; (4) enduring pressure; and (5) lack of guidance from healthcare

providers. The two most salient themes were "experimenting with different methods" and "lack of guidance from healthcare providers". For the women, the journey to finding the method that ultimately allowed them to detect ovulation and conceive was a journey of trial and error through testing multiple fertility-awareness methods. The women also emphasized a lack of support from healthcare providers regarding natural methods to conceive. Findings underscore that women preferred using natural ways to detect ovulation and would recommend other women to do so, but with healthcare providers' guidance.

Summary and Implications

Summary

A woman and her partner's journey to achieve a desired pregnancy is unique and multifaceted. The Traits-Desires-Intentions-Behavior framework was used to guide the inquiry of pregnancy intention and FABM behavior. The first major finding of this dissertation is that fertility knowledge, specifically among women who are trying to conceive or are having difficulty conceiving, is low. If women are not confident in predicting ovulation, then they may be mis-timing the fertile window, and engaging in intercourse at times that will not lead to conception. Second, the use of FABMs is underutilized by women seeking conception. FABMs are natural, safe, inexpensive ways to detect the fertile window and the infrequent use of these methods may contribute to unnecessary referral to ART. Third, duration of ongoing pregnancy attempt is predictive of number of fertility-awareness based methods a woman will use. And finally, this body of work found that women desire health care providers guidance on FABMs when they are seeking conception.

Implications

Research Implications

Fertility Knowledge. In the first study (Chapter II), there were multiple instruments to measure fertility knowledge and the application of such instruments had not been extending to the clinical setting. Establishing a baseline of a woman's fertility knowledge and her potential success with a FABM could spare the woman the exorbitant cost, emotional strain, and potential complications of ART. Similarly to how the Edinburg Postnatal Depression Screen is administered to women during their 6 week postpartum visit to measure postpartum depression, it would be useful to have a clinical tool to measure someone's fertility knowledge and be able to advise on FABMs according to their future pregnancy intentions during either a pre-conception visit or well-women annual exam. Future research should consider the application of a validated fertility knowledge instrument to assess women's baseline knowledge in clinical practice.

FABM Use. In Chapter III, we found that FABMs were underutilized among women who had sought advice from a health care provider regarding pregnancy. Chapter IV validated that well-established methods of fertility awareness were underutilized among women seeking conception. We discovered in Chapter III and Chapter IV that the most frequently used method to monitor for ovulation was keeping track of the menstrual cycle, although methods that allow for prediction of ovulation, rather than retrospective evaluation of the fertile window are available. Future research is needed to discover why fertility-awareness based methods are underutilized. Chapter IV identified that duration of time trying was predictive of how many fertility methods were used, but it would be interesting to see in future research if there is a trend in method use progression, such as the progressive experimentation that was a theme in Chapter V. As discussed in Chapter II, women seek out different sources for fertility knowledge, therefore research is needed to explore if that which women are most frequently using correlates with what providers are frequently recommending, and if not, examine where women receive

information about fertility methods. Results from continued research in this area can inform future educational based interventions for increasing fertility-awareness among women actively seeking pregnancy.

Provider Guidance. Chapter II explored the research regarding women's fertility knowledge, but future research should also explore provider knowledge around delivery of FABM education before specialist referral. Barriers and facilitators to implementing FABM education in practice by general practitioners have been explored by Hampton et al. (2016), in an Australian population, but future research dedicated to identifying barriers and facilitators for providers practicing in the United States is essential. Chapter V highlighted that there is an important need for healthcare providers' guidance on using FABMs. If providers lack confidence in this area, then research is needed to explore how to deliver FABM educational interventions so that providers can be successful. Designing, evaluating and validating education-based interventions for providers is an opportunity for continued research in this area. Future research is warranted to elucidate the optimal time when women should receive this education and the type of visit i.e. routine annual exam or pre-conception counseling visit where it should be given.

Desire and Intention. Chapter IV included women who stated that they were not actively trying to conceive (without intention), but that they may become pregnant within the next year (with desire). Although the focus of Chapter IV was on women actively trying to achieve as it related to their current duration of pregnancy attempt, an area for future research is on understanding what affects women's fertility monitoring behaviors over time in the group of women who stated that they may become pregnant within the next year. It would be interesting to examine longitudinally the influences that effect women's switch from desiring pregnancy in

the future to actively intending to become pregnant. Understanding what drives women's pregnancy intentions is an area for future research.

Theoretical Implications

The Traits-Desires-Intentions-Behavior conceptual framework was specifically chosen for this dissertation work because it provided guidance for the selection of predictors that specifically influence reproductive choices. The motivations a person has to bear children lies at the very core of all social and behavioral science efforts to understand reproductive behavior. Because the framework was based on the construct of motivation, and integrated other constructs such as attitudes, values, norms, desires, and intentions into it, it was useful to examine differences in family planning choices among a group of women pursuing pregnancy. The framework acknowledges that there are important factors that may affect behavior, and a focus of this body of work was to explore specifically what factors predict fertility-awareness based method use.

The first three specific aims of the dissertation were guided by the T-D-I-B framework. The first aim (Chapter II) focused on fertility knowledge as a trait. Knowledge is considered a "trait" in the T-D-I-B framework because how knowledgeable a person is about pregnancy and fertility may play a role in the activation of desiring a pregnancy. It was essential that a comprehensive literature review be conducted first to understand what women know about fertility before the evaluation of fertility-awareness based method use. The study found that knowledge regarding the time in the cycle in which to conceive was low among the women studied, as was the utilization of methods to track fertility.

The second aim (Chapter II) used the T-D-I-B framework to guide variable selection in a the subset of women from the National Survey of Family Growth (2015-2017). According to the

theory, traits that play a role in the activation of desire include age, gender-role orientation, family composition, marital support, religion, income, and education level. Chapter II used logistic regression to explore age, marital status, education, religion, employment status, and health insurance status as predictors for fertility-awareness based method use. Although these traits may be significant factors in deciding a person's desire and intention for pregnancy, in this body of work, we found that they were not significant factors in deciding whether a woman would use a method of fertility awareness, nor her fertility method preference.

The third aim (Chapter IV) used the T-D-I-B framework to explore if duration of pregnancy attempt in the Nurses' Health Study III would influence type and number of FABM(s) chosen. The only thing that was predictive of number of fertility methods used was current duration of pregnancy attempt among women actively trying to conceive. Miller described intentions in the T-D-I-B framework as the psychological states that represent what someone actually plans to do. Intentions are based on desire but take into consideration what can actually be achieved. Chapter IV found that the only predictor of number of fertility methods in a multivariable model was the length of the women's current duration of pregnancy attempt, or the length of time in months that she had been intending pregnancy. This is an interesting contribution to what we know about women's pregnancy intentions and their fertility monitoring behaviors.

The T-D-I-B framework acknowledges that there are important factors that may affect proceptive (achieve) behavior. Factors include the occurrence of major events or some barrier (infertility) and social support or lack of support. The themes of "enduring pressures" and "lack of guidance from healthcare providers" in Chapter V, speak to the occurrences of such barriers. Because guidance from health care providers on fertility-awareness based methods may

influence FABM practices, a lack of provider guidance on well-established FABMs could prolong the duration of pregnancy attempt. The theme of "experimenting with different methods" contributes to our theoretical understanding about the process a woman may undergo when intending pregnancy, such as the process of trial and error of multiple fertility awareness methods.

Future use of the T-D-I-B framework could focus more on "desire", and what may lead a woman to or from intention of pregnancy. A subset of the sample in Chapter IV were women who stated that they may become pregnant within the next year. This sample represents women who desire, but who are not yet intending pregnancy. Expanding this model to understand better what shapes women's movement from desire to intention is an area for future research. Miller described that desires may or may not lead to intention because one must consider the desires and intentions of the partner or situational considerations, such as unemployment, lack of financial resources, or crowded living situation, but it would be interested to study in a population of women who state that they may become pregnant within the next year, what influences that desire, and what prohibits the desire from moving to intention.

Clinical Implications

This body of research supports that FABMs are underutilized and the lack of fertility education to support natural conception is a prevalent problem. Educating women on FABMs is necessary to improve conception rates and subsequently reduce unnecessary medical interventions and cost. Implementing fertility-awareness based education in practice is a safe and an inexpensive initial intervention for women seeking pregnancy. Nurses, nurse practitioners, and nurse midwives are the ideal practitioners to provide FABM education because nurses understand that art and science that is required of evidenced-based FABM education. Such

education may also mitigate stress and improve emotional well-being in women during the time to successful conception. Health care providers need not wait until a woman has expressed difficulty achieving pregnancy. Educating childbearing aged women may help avoid fertility health risks and protect their current and future fertility. Women may also seek education regarding FABMs for the purpose of avoiding pregnancy and this education is useful throughout reproductive life. There are a number of credible resources on the different methods of FABM for health care professionals to refer women to.

Nursing Education Implications

In order for nurses, nurse practitioners, and nurse midwives to feel confident delivering FABM education, they must be educated regarding these methods. It is important for nursing students to have a strong foundation in the physiological understanding of natural biomarkers of fertility. Students must be knowledgeable on all of FABMs methods, so that as nurses they may correctly help their patients identify the fertile window and be successful with their chosen method. Continuing education dedicated to FABMs is necessary to keep nurses up-to-date with the science.

Policy Implications

The Access to Infertility Treatment and Care Act (S.2960) (H.R. 2803) bill, currently in House and Senate committees at the writing of this dissertation, proposes an amendment to the Public Health Service Act that would require private health insurance plans that cover obstetric services to also cover infertility treatments (eg, in vitro fertilization) (Booker, 2018; DeLauro, 2019). Although the bill would improve access to infertility services, it likely carries unintended consequences related to the overuse of infertility services. Despite limited knowledge about fertility and use of fertility-awareness methods, referrals to assisted reproductive technology

(ART) rely heavily on patient self-report of ovulation. Additionally, the utilization of in vitro fertilization (IVF) appears to be 1.5 times higher in states with mandated IVF insurance coverage (MA, NH, IL) (Weigel et al., 2020). If the Access to Infertility Treatment and Care Act (S.2960) (H.R. 2803) bill is passed and infertility treatment becomes more accessible to persons with health insurance plans that cover obstetric services, it is important to ensure that each referral is appropriate and high value, thus protecting patients and the system against the high-cost burden and harmful effects of unnecessary, invasive care. There is no language in the proposed bill to safeguard against these consequences and, if passed, insurers would be mandated to provide infertility services without a less invasive trial of a fertility-awareness based method, which nurses are well suited to implement. Ideally, there should be a mechanism in the implementation of the bill that insurers will uphold a protocol through which women display evidence of a trial of ovulation tracking (either through cervical mucus, basal body temperature, ovulation predictor kits, etc.) before referral. This trial could potentially reduce the number of women who would need infertility services and subsequently lower the overall costs of the bill. Furthermore, it addresses the call to decrease healthcare spending while improving healthcare outcomes through health promotion. Education on fertility-awareness–based methods can be provided to all women who desire pregnancy regardless of their current insurance coverage.

Individual nurses, as well as NP professional organizations, should monitor the language and potential implementation issues as the Access to Infertility Treatment and Care Act (S.2960) (H.R. 2803) advances through the policy process. This is an ideal opportunity for nurses to maintain their voice as advocates on behalf of the best interest of their patients.

Strengths. This program of research has a number of strengths. A variety of data sources and methods were used in a stepwise manner to collectively form a single, cohesive body of work. This dissertation includes a thorough review of the literature, two quantitative studies that used large national data, and piloted a qualitative methodology to explore this phenomena. Through careful consideration of traits, desires, and intentions of childbearing aged women who sought pregnancy, the cumulative findings of this body of work explored the many factors that influence a women's fertility-tracking behavior.

For women who are trying to conceive, it is critical for clinicians to assess their general knowledge regarding fertility and fertility-awareness practices to identify the fertile window. The thorough integrative review to synthesize the literature regarding fertility knowledge and women's attitudes towards FABMS was essential to specifically identify how knowledgeable women who seek pregnancy were about fertility. The review highlighted that fertility knowledge regarding the time in the cycle in which to conceive was low, which supported the need for more research into the fertility tracking behaviors of women who seek conception.

Using the National Survey of Family Growth (NSFG), 2015-2017 sample helped determine that historic use of fertility methods were underutilized among women who had sought advice from a health care professional on becoming pregnant, and that there were no significant predictors of fertility method use. These results guided the next study which aimed to examine women who were actively trying to achieve pregnancy and their fertility tracking behaviors as it related to duration of months trying to conceive in a second large national sample, the Nurses' Health Study III. The qualitative case study allowed women to tell their personal experiences using multiple FABMs on their journey to pregnancy and conveyed important themes for clinicians to consider when women are trying to achieve. The findings of this body of

work were presented in a way that should convince providers to encourage women who seek pregnancy to use FABMs before referral to ART.

Limitations. Despite the many strengths of this body of work, it is important to note several limitations. Both secondary analyses on nationally representative samples were limited, as they examined cross-sectional data. While the cross-sectional designs for these studies were useful to gather preliminary data to support future research and experimentation, the results cannot be used to determine causal relationships. Additionally, both these secondary analyses used datasets derived from surveys/questionnaires, which do not employ the use of validated and psychometrically sound measures. As with all secondary analyses, the studies were limited to the variables measured. Furthermore, the sample sizes in both secondary analyses studies lacked diversity in the demographic characteristics. To understand the real world implications of our findings, future research is necessary to replicate these studies using a broader spectrum of women across the United States.

Conclusion

As the cost of infertility treatments increase and the incidence of infertility rises, nurses are well positioned to be advocates of high-value, low-risk care for their pregnancy-seeking patients. Each aim of the dissertation served as a cumulative step towards understanding fertility-awareness based method use among women seeking pregnancy. Understanding the experiences of women and their fertility tracking behaviors is essential to providing holistic, patient-centered care, which nurses are well positioned to provide. The fusion of findings from this body of research has revealed a shortcoming in how women who are seeking pregnancy are counselled around FABMs. Education on fertility-awareness–based methods can and should be provided to

all reproductive-aged women, as a means for high quality, cost-saving, non-invasive, natural, and safe care.

Master Reference List

American College of Obstetricians and Gynecologists (AGOG) (2019). Infertility workup for the

women's health specialist: ACOG committee opinion, number 781. (2019). *Obstetrics &*

Gynecology, *133*(6), e377–e384. https://doi-

org.proxy.bc.edu/10.1097/AOG.0000000000003271

Amutah, N., Gifuni, J., & Wesley, Y. (2016). Shaping the conversation: A secondary analysis of

reproductive decision-making among black mothers with HIV. *Clinical Medicine*

Insights: Women's Health, *9*, 1. https://doi.org/10.4137/CMWH.S34671

Anderson, C., & Kirkpatrick, S. (2016). Narrative interviewing. *International Journal of Clinical*

Pharmacy, *38*(3), 631–634. https://doi.org/10.1007/s11096-015-0222-0

Bao, Y., Bertoia, M. L., Lenart, E. B., Stampfer, M. J., Willett, W. C., Speizer, F. E., &

Chavarro, J. E. (2016). Origin, methods, and evolution of the three nurses' health studies.

American Journal of Public Health, *106*(9), 1573–1581.

https://doi.org/10.2105/AJPH.2016.303338

Bigelow, J.L., Dunson, D.B., Stanford, J.B., Ecochard, R., Gnoth, C.,

& Colombo, B. (2004). Mucus observations in the fertile window: A better predictor of

conception than timing of intercourse. *Human Reproduction, 19*(4), 889–892.

doi:10.1093/humrep/deh173.

Blake, D., Smith, D., Bargiacchi, A., France, M., & Gudex, G. (1997). Fertility awareness in

women attending a fertility clinic. *Australian & New Zealand Journal of Obstetrics &*

Gynaecology, *37*(3), 350–352. https://doi.org/10.1111/j.1479-828X.1997.tb02429.x

Booker, C. (2018). Text - S.2960 - 115th Congress. Access to infertility treatment and care act.

https://www.congress.gov/bill/115th-congress/senate-bill/2960/text.

Bromer, J. G., Ata, B., Seli, M., Lockwood, C. J., & Seli, E. (2011). Preterm deliveries that result

    from multiple pregnancies associated with assisted reproductive technologies in the USA:

    a cost analysis. *Current Opinion in Obstetrics & Gynecology*, *23*(3), 168–173. https://doi-

    org.proxy.bc.edu/10.1097/GCO.0b013e32834551cd

Bunting, L., Tsibulsky, I., Boivin, J. (2013). Fertility knowledge and beliefs about fertility

    treatment: Findings from the International Fertility Decision-making Study, *Human*

    Reproduction 28 (2), 385–397. https://doi.org/10.1093/humrep/des402

Centers for Disease Control and Prevention. (2019, April 4). Infertility

    FAQs. https://www.cdc.gov/reproductivehealth/infertility/index.htm.

Childress, K. J., Lawson, A. K., Ghant, M. S., Mendoza, G., Cardoza, E. R., Confino, E., &

    Marsh, E. E. (2015). First Contact: The intersection of demographics, knowledge, and

    appraisal of treatment at the initial infertility visit. *Fertility and Sterility*, *104*(1), 180–

    187. https://doi.org/10.1016/j.fertnstert.2015.04.002

Daar, J., Amato, P., Benward, J., Collins, L.R., Davis, J., Francis, L., Gates, E., Klipstein, S.,

    Koenig, B., McCullough, L., Reindollar, R., Sauer, M., Sokol, R., Stein, A., Tipton, S.

    (2015). Disparities in access to effective treatment for infertility in the United States: an

    Ethics Committee opinion. *Fertility & Sterility*, *104*(5), 1104–1110. https://doi-

    org.proxy.bc.edu/10.1016/j.fertnstert.2015.07.1139

Duane, M., Contreras, A., Jensen, E.T., & White, A. (2016). The performance of fertility

    awareness-based method apps marketed to avoid pregnancy. *Journal of the American*

    Board of Family Medicine 29(4), 508–11. doi: 10.3122/jabfm.2016.04.160022. PMID:

    27390383.

Doroski, D. (2014). How *Humanae Vitae* has advanced reproductive health. *The Linacre Quarterly, 81*(3), 286-294. DOI 10.1179/2050854914Y.0000000028

Ecochard, R., Duterque, O., Leiva, R., Bouchard, T., & Vigil, P. (2015). Self-identification of the clinical fertile window and the ovulation period. *Fertility and Sterility, 103*(5), 1319–1325. doi:10.1016/j.fertnstert.2015.01.031.

FACTS. (n.d.). Homepage. Retrieved from https://factsaboutfertility.org.

Fehring, R.J. (2004). The future of professional education in natural family planning. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*, 33(1), 34–43. doi:10.1177/0884217503258549.

Finocchario-Kessler, S., Sweat, M. D., Dariotis, J. K., Anderson, J. R., Jennings, J. M., Keller, J. M., Vyas, A. A., & Trent, M. E. (2012). Childbearing motivations, pregnancy desires, and perceived partner response to a pregnancy among urban female youth: Does HIV-infection status make a difference? *AIDS Care*, *24*(1), 1–11. https://doi.org/10.1080/09540121.2011.596514

Fu, M.R., Xu, B., Liu, Y., & Haber, J. (2008). 'Making the best of it': Chinese women's experiences of adjusting to breast cancer diagnosis and treatment. *Journal of Advanced Nursing*, *63*(2), 155–165. https://doi.org/10.1111/j.1365-2648.2008.04647.x

Fu, M.R, & Rosedale, M. (2009). Breast cancer survivors' experiences of lymphedema-related symptoms. *Journal of Pain and Symptom Management*, *38*(6), 849–859. https://doi.org/10.1016/j.jpainsymman.2009.04.030

Fulford, B., Bunting, L., Tsibulsky, I., & Boivin, J. (2013). The role of knowledge and perceived susceptibility in intentions to optimize fertility: Findings from the International Fertility

Decision-Making Study (IFDMS). *Human Reproduction*, *28*(12), 3253–3262.

https://doi.org/10.1093/humrep/det373

Gaskins, A. J., Rich-Edwards, J. W., Lawson, C. C., Schernhammer, E. S., Missmer, S. A., & Chavarro, J. E. (2015). Work schedule and physical factors in relation to fecundity in nurses. *Occupational and Environmental Medicine*, *72*(11), 777–783.

https://doi.org/10.1136/oemed-2015-103026

Gaskins, A. J., Rich-Edwards, J. W., Missmer, S. A., Rosner, B., & Chavarro, J. E. (2015). Association of fecundity with changes in adult female weight. *Obstetrics and Gynecology*, *126*(4), 850–858. https://doi.org/10.1097/AOG.0000000000001030

Gnoth, C., Godehardt, E., Frank-Herrmann, P., Friol, K., Tigges, J., & Freundl, G. (2005). Definition and prevalence of subfertility and infertility. *Human reproduction (Oxford, England)*, *20*(5), 1144–1147. https://doi.org/10.1093/humrep/deh870

Good MJDV, Munakata T, Kobayashi Y, et al. (1994).Oncology and narrative time. *Soc Sci Med 38(*6): 855–862.

Good MJDV.(1995). Competence and clinical narratives in oncology. In: *American medicine: the quest for competence*, Berkeley, CA: University of California Press, 177–196.

Haas, J. (1998). "Begotten not made: A catholic view of reproductive technology" https://www.usccb.org/committees/pro-life-activities/begotten-not-made-catholic-view-reproductive-technology

Hampton, K. D., Mazza, D., & Newton, J. M. (2013). Fertility-awareness knowledge, attitudes, and practices of women seeking fertility assistance. *Journal of Advanced Nursing, 69*(5), 1076-1084. https://doi.org/10.1111/j.1365-2648.2012.06095.x

Hampton, K. D., Newton, J. M., Parker, R., & Mazza, D. (2016). A qualitative study of the

    barriers and enablers to fertility-awareness education in general practice. *Journal of*

    Advanced Nursing, 72(7), 1541-1551. https://doi.org/10.1111/jan.12931

Hawkins, J.W., Roberto-Nichols, D.M., & Stanley-Haney, J.L. (2016). Guidelines for nurse

    practitioners in gynecologic settings (11th ed.). Springer Publishing Company.

Hoffman, J. R., Delaney, M. A., Valdes, C. T., Herrera, D., Washington, S. L., Aghajanova, L.,

    Smith, J. F., & Herndon, C. N. (2020). Disparities in fertility knowledge among women

    from low and high resource settings presenting for fertility care in two United States

    metropolitan centers. *Fertility Research and Practice*, *6*(1), 15.

    https://doi.org/10.1186/s40738-020-00084-1

Infertility Workup for the Women's Health Specialist: ACOG Committee Opinion, Number 781.

    (2019). *Obstetrics & Gynecology*, *133*(6), e377–e384. https://doi-

    org.proxy.bc.edu/10.1097/AOG.0000000000003271

Joffe, M., Villard, L., Li, Z., Plowman, R., & Vessey, M. (1993). Long-term recall of time-to-

    pregnancy. *Fertility and Sterility*, *60*(1), 99–104. https://doi.org/10.1016/s0015-

    0282(16)56044-0

Lincoln, Y.S.& Guba, E. (1985) Naturalistic Inquiry. 1st edition. SAGE Publications.

Lowe, N. K. (2019). What Is a Pilot Study?. *Journal of obstetric, gynecologic, and neonatal*

    nursing : JOGNN, *48*(2), 117–118. https://doi.org/10.1016/j.jogn.2019.01.005

Maeda, E., Sugimori, H., Nakamura, F., Kobayashi, Y., Green, J., Suka, M., Okamoto, M.,

    Boivin, J., & Saito, H. (2015). A cross sectional study on fertility knowledge in Japan,

    measured with the Japanese version of Cardiff Fertility Knowledge Scale (CFKS-J).

    Reproductive Health, *12*. https://doi.org/10.1186/1742-4755-12-10

Mahey, R., Gupta, M., Kandpal, S., Malhotra, N., Vanamail, P., Singh, N., & Kriplani, A. (2018). Fertility awareness and knowledge among Indian women attending an infertility clinic: A cross-sectional study. *BMC Women's Health*, *18*(1), 177–177. https://doi.org/10.1186/s12905-018-0669-y

Manders, M., McLindon, L., Schulze, B., Beckmann, M. M., Kremer, J. A. M., & Farquhar, C. (2015). Timed intercourse for couples trying to conceive. *Cochrane Database of Systematic Reviews*, *3*, CD011345. https://doi.org/10.1002/14651858.CD011345.pub2

Manhart, M.D, & Fehring, R.J. (2018). The state of the science of natural family planning fifty years after *Humanae Vitae*: A report from NFP scientists; meeting held at the US conference of catholic bishops, April 4, 2018. *The Linacre Quarterly,85*(4), 339–347. https://doi.org/10.1177/0024363918809699

Mascarenhas, M. N., Flaxman, S. R., Boerma, T., Vanderpoel, S., & Stevens, G. A. (2012). National, regional, and global trends in infertility prevalence since 1990: A systematic analysis of 277 health surveys. *PLoS Medicine, 9*(12), e1001356. https://doi: 10.1371/journal.pmed.1001356.

Miller, W. (1994). Childbearing motivations, desires, and intentions: A theoretical framework. *Genetic, Social, and General Psychology Monographs*, *120*, 223–258.

Miller, W. B. (2011a). Comparing the TPB and the T-D-I-B framework. *Vienna Yearbook of Population Research*, *9*, 19–29.

Miller, W. B. (2011b). Differences between fertility desires and intentions: Implications for theory, research and policy. *Vienna Yearbook of Population Research*, *9*, 75–98.

Miller, W. B., Severy, L. J., & Pasta, D. J. (2004). A framework for modelling fertility motivation in Couples. *Population Studies*, *58*(2), 193–205.

Miller, W.B., Jones, J., & Pasta, D. (2016). An implicit ambivalence- indifference dimension of childbearing desires in the National Survey of Family Growth. *Demographic Research 34* (7), 203-242.

Mu, Q., Hanson, L., Hoelzle, J., & Fehring, R. J. (2019). Young women's knowledge about fertility and their fertility health risk factors. *Journal of obstetric, gynecologic, and neonatal nursing : JOGNN*, *48*(2), 153–162. https://doi.org/10.1016/j.jogn.2018.12.009

Mynarska, M., & Rytel, J. (2018). From motives through desires to intentions: Investigating the reproductive choices of childless men and women in Poland. *Journal of Biosocial Science*, *50*(3), 421–433. https://doi.org/10.1017/S0021932017000190

National Center for Health Statistics. National Survey of Family Growth, 2015–2017. Public-use data file and documentation. https://www.cdc.gov/nchs/nsfg/about_nsfg.htm.

Naugler, M. R., & DiCARLO, K. (2018). Barriers to and interventions that increase nurses' and parents' compliance with safe sleep recommendations for preterm infants. *Nursing for Women's Health*, *22*(1), 24–39. https://doi.org/10.1016/j.nwh.2017.12.009

Patil, M. (2012). Ectopic pregnancy after infertility treatment. *Journal of human reproductive sciences*, *5*(2), 154–165. https://doi.org/10.4103/0974-1208.101011

V.I. Paul. Humanae vitae [Encyclical]. https://www.vatican.va/content/paul-vi/en/encyclicals/documents/hf_p-vi_enc_25071968_humanae-vitae.html, 1968.

Pfeifer, S., Butts, S., Fossum, G., Gracia, C., La Barbera, A., Mersereau, J., Odem, R., Paulson, R., Penzias, A., Pisarska, M., Rebar, R., Reindollar, R., Rosen, M., Sandlow, J., & Vernon, M. (2017). Optimizing natural fertility: A committee opinion. *Fertility and Sterility*, *107*(1), 52–58. https://doi.org/10.1016/j.fertnstert.2016.09.029

Public Health Service Act of 1944, 42 U.S.C. 242k, § 306(b) 1(H).

Qiu, J. M., & DelVecchio Good, M.-J. (2020). Making the best of multidisciplinary care for patients with malignant fungating wounds: A qualitative study of clinicians' narratives. *Palliative Medicine*, 0269216320966498. https://doi.org/10.1177/0269216320966498

Righarts, A., Dickson, N. P., Parkin, L., & Gillett, W. R. (2017). Ovulation monitoring and fertility knowledge: Their relationship to fertility experience in a cross-sectional study. *Australian & New Zealand Journal of Obstetrics & Gynaecology*, *57*(4), 412–419. https://doi.org/10.1111/ajo.12606

Scarpa, B., Dunson, D.B., & Giacchi, E. (2007). Bayesian selection of optimal rules for timing intercourse to conceive by using calendar and mucus. *Fertility and Sterility, 88*(4), 915–924. doi:10.1016/j.fertnstert.2006.12.017.

Stanford, J.B., Schliep, K.C., Chang, C., O'Sullivan, J., Porucznik, C.A., Chang, C.-P., & O'Sullivan, J.-P. (2020). Comparison of woman-picked, expert-picked, and computer-picked peak day of cervical mucus with blinded urine luteinising hormone surge for concurrent identification of ovulation. *Paediatric & Perinatal Epidemiology, 34*(2), 105–113. doi:10.1111/ppe.12642.

Stanford, J.B., White, G.L., Jr., & Hatasaka, H. (2002). Timing intercourse to achieve pregnancy: Current evidence. *Obstetrics & Gynecology, 100*(6), 1333–1341. doi:10.1016/s0029-7844(02)02382-7.

Srikanthan, A., & Reid, R. L. (2008). Religious and cultural influences on contraception. *Journal of obstetrics and gynaecology Canada : JOGC = Journal d'obstetrique et gynecologie du Canada : JOGC*, *30*(2), 129–137. https://doi.org/10.1016/S1701-2163(16)32736-0

Wagner, A. C., Ivanova, E. L., Hart, T. A., & Loutfy, M. R. (2014). Examining the traits-desires-intentions-behavior (TDIB) model for fertility planning in women living with HIV in

Ontario, Canada. *AIDS Patient Care and STDs*, *28*(11), 594–601.

https://doi.org/10.1089/apc.2014.0075

Weigel, G., Ranji, U., Long, M. (2020). Coverage and use of fertility services in the U.S. *KFF*.

https://www.kff.org/womens-health-policy/issue-brief/coverage-and-use-of-fertility-services-in-the-u-s/.

World Health Organization. Natural family planning: A guide to provision of

services. https://apps.who.int/iris/bitstream/handle/10665/39322/9241542411-eng.pdf?sequence=1&isAllowed=y, 1988.

Wu, A.K., Odisho, A.Y., Washington, S.L., Katz, P.P., & Smith, J.F. (2014). Out-of-pocket

fertility patient expense: Data from a multicenter prospective infertility cohort. *Journal of Urology, 191*(2), 427–432. doi:10.1016/j.juro.2013.08.083.

Zegers-Hochschild, F., Adamson, G. D., Dyer, S., Racowsky, C., de Mouzon, J., Sokol, R.,

Rienzi, L., Sunde, A., Schmidt, L., Cooke, I. D., Simpson, J. L., & van der Poel, S.

(2017). The international glossary on infertility and fertility care. *Fertility and sterility*, *108*(3), 393–406. https://doi.org/10.1016/j.fertnstert.2017.06.005