

Variability in the Phases of the Menstrual Cycle

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Objective: To determine variability in the phases of the menstrual cycle among healthy, regularly cycling women.

Design: A prospective descriptive study of a new data set with biological markers to estimate parameters of the menstrual cycles.

Participants: One hundred forty one healthy women (mean age 29 years) who monitored 3 to 13 menstrual cycles with an electronic fertility monitor and produced 1,060 usable cycles of data.

Measures and Outcomes: Variability in the length of the menstrual cycle and of the follicular, fertile, and luteal phases, and menses. The estimated day of ovulation and end of the fertile phase was the peak fertility reading on the monitor (i.e., the urinary luteinizing hormone surge).

Results: Mean total length was 28.9 days ($SD = 3.4$) with 95% of the cycles between 22 and 36 days. Intracycle variability of greater than 7 days was observed in 42.5% of the women. Ninety-five percent of the cycles had all 6 days of fertile phase between days 4 and 23, but only 25% of participants had all days of the fertile phase between days 10 and 17.

Conclusions: Among regularly cycling women, there is considerable normal variability in the phases of the menstrual cycle. The follicular phase contributes most to this variability. *JOGNN*, 35, 376-384; 2006. DOI: 10.1111/j.1552-6909.2006.00051.x.

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Knowledge of menstrual cycle variability is critical for women who use fertility awareness-based methods to avoid or achieve pregnancy. Knowledge of the

variability of the fertile phase of the menstrual cycle is of particular import for couples having difficulty achieving pregnancy. Furthermore, it is important to know normal variations of the menstrual cycle, since the menstrual cycle is used as a sign of women's health. However, little is known about the variability of the fertile and other phases of the menstrual cycle. There are few large data sets that include accurate measures of menstrual cycle parameters. This article reviews evidence on menstrual cycle variability and provides new information based on a data set generated by women using an electronic hormonal fertility monitor.

Classical longitudinal studies on menstrual cycle variability by Treloar, Boynton, Behn, and Brown (1967) and Vollman (1977) and a large cross-sectional study by Chiazze, Brayer, Macisco, Parker, and Duffy (1968) demonstrated that based on length, the greatest variability of the menstrual cycle occurs at the two ends of the life span of fertility, that is, the 1st few years after menarche and the 2 to 3 years leading up to menopause. They also demonstrated that mean cycle lengths decrease as women age. Treloar et al. (1967) and Chiazze et al. (1968) did not provide information on the variability of the phases of the menstrual cycle. Vollman used the basal body temperature (BBT) shift as a marker of ovulation and determined that the follicular phase ranged from approximately 11 to 27 days and the luteal phase from 7 to 15 days. The use of the BBT shift as an estimate of ovulation, however, is rather imprecise (Barron & Fehring, 2005).

Researchers also have shown that there is greater variability in menstrual cycle length in the 1st few cycles after ovulation returns postchildbirth and breastfeeding (Zinaman & Stevenson, 1991), after

discontinuation of hormonal contraception (Gnoth, Frank-Hermann, Schmoll, Godehardt, & Freundl, 2002), during times of stress (Barsom, Mansfield, Koch, Gierach, & West, 2004; Fenster et al., 1999), and with lifestyle factors such as excess exercise, obesity, smoking, and diet (Rowland et al., 2002; Solomon et al., 2001). Although some of these studies used various biological markers for estimating the phases of the menstrual cycle (e.g., serum level of luteinizing hormone [LH]), for the most part, variability was examined as a result of special circumstances and not as normal variations with regular cycle data.

Recent studies have contributed to our knowledge of normal variability of the length of the menstrual cycle (Creinin, Keverline, & Meyn, 2004; Munster, Schmidt, & Helm, 1992) and of the luteal phase (Lenton, Landgren, & Sexton, 1984). Munster et al. (1992) demonstrated that among a cohort of 3,743 Danish women aged 15 to 44, menstrual cycle variation of greater than 14 days was present in 29.3% of all women. More recently, Creinin et al. (2004) found that among 130 healthy U.S. women (who generated 786 cycles of data), 46% had cycle length ranges of 7 days or more, and 20% had cycle length ranges of 14 days or more. The studies of Munster et al. and the Creinin et al. did not have data to examine the variability of the fertile and luteal phases among the participants. Lenton et al. (1984) found that with a small data set of 327 menstrual cycles, the normal range of the luteal phase (based on urinary LH testing) was between 12 and 17 days. This study did not examine within-woman luteal phase variability.

Wilcox, Dunson, and Baird (2000) provided evidence for the variability of the 6-day fertile phase of the menstrual cycle, stated there is some probability that days of the fertile phase can occur on almost any day of the menstrual cycle, and concluded that only 30% of women have all of the days of their fertile phase between days 10 and 17 of the menstrual cycle. Wilcox, Weinberg, and Baird (1995), Dunson, Baird, Wilcox, and Weinberg (1999), and Wilcox et al. (2000) previously demonstrated that the fertile phase of the menstrual cycle is approximately 6 days: the day of ovulation and the 5 days before. These three studies were based on a data set of 696 ovulatory menstrual cycles from 221 healthy women who documented their fertility by use of urinary estrogen and progesterone ratios. There is a need to document these findings with other data sets.

There are many causes of menstrual cycle variability: causes that essentially disrupt or suppress the rhythms of the hypothalamic-pituitary-ovarian axis. Most of the variability in the follicular phase is thought to be due to defects in the process of ovulation (Speroff & Fritz, 2005). Variability in the luteal phase could be a result of defects in the ovulatory process but also of defects in the corpus luteum and inadequate production of estrogen and progesterone. The variability of the luteal phase is thought to

be less than that of the follicular phase. How the variability of each phase differs or relate to one another is unknown. Understanding normal variability of the menstrual cycle is important since the menstrual cycle can be a sign of health and disease for women.

This study determined normal variability in the follicular, luteal, fertile, and menses phases of the menstrual cycle among healthy, regularly cycling women.

A new data set of menstrual cycles has been developed with biological markers (e.g., threshold levels of urinary estrogen and LH) that provide a good estimate of the day of ovulation, and of the follicular, fertile, and luteal phases of the menstrual cycle. The purpose of this study was to determine inter(women) and intra(woman) variability of the phases of the menstrual cycle with a new data set of menstrual cycles generated by healthy, regularly cycling women. The specific research questions were as follows:

1. What is the variability in the length of the menstrual cycle?
2. What is the variability in the phases (i.e., follicular, fertile, luteal, and menses) of the menstrual cycle?
3. How do phases of the menstrual cycle relate and differ from one another?

Methods

Design

This was a descriptive analysis of the phases of the menstrual cycle by use of a new menstrual cycle data set. The data set was generated by 165 women who participated in an effectiveness study of an electronic fertility monitor for family planning purposes.

Sample

All 165 women volunteers sought to learn how to monitor their fertility for the purpose of avoiding pregnancy by use of an electronic fertility monitor called the Clearblue (also called Clearplan) Easy Fertility Monitor (Unipath Diagnostics, Inc., Waltham, MA) at five clinical sites in four cities (Atlanta, Madison, Milwaukee, and Saint Louis). To participate in the study, the volunteers had to be between the age of 21 and 44; have menstrual cycles between 21 and 42 days; had not used depot

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