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The menstrual cycle is influenced by weekly and lunar rhythms

René Ecochard, M.D., Ph.D.,[a,b] Rene Leiva, M.D.,[c,d] Thomas P. Bouchard, M.D.,[e] Agathe Van Lamsweerde, M.Sc.,[f] Jack T. Pearson, Ph.D.,[f] Joseph B. Stanford, M.D., M.S.P.H.,[g] and Claude Gronfier, Ph.D.[h]

[a] Pôle de Santé Publique, Service de Biostatistique, Lyon, France; [b] Laboratoire Biostatistique Santé, Université Claude Bernard Lyon I, Lyon, France; [c] Bruyère Research Institute, CT Lamont Primary Health Care Research Centre, Ottawa, Ontario, Canada; [d] Department of Family Medicine, University of Ottawa, Ottawa, Ontario, Canada; [e] Department of Family Medicine, University of Calgary, Calgary, Alberta, Canada; [f] Natural Cycles AB, Stockholm, Sweden; [g] Office of Cooperative Reproductive Health, Division of Public Health Department of Family and Preventive Medicine, University of Utah, Salt Lake City, Utah; and [h] Centre de Recherche en Neurosciences de Lyon (CRNL), Neurocampus, Université de Lyon, Lyon, France

Objective: To study whether the menstrual cycle has a circaseptan (7 days) rhythm and whether it is associated with the lunar cycle (also defined as the synodic month, it is the cycle of the phases of the Moon as seen from Earth, averaging 29.5 days in length).
Design: Cross-sectional study.
Subjects: A total of 35,940 European and North American women aged 18–40 years.
Exposure: Data were collected in real-life conditions.
Intervention: No intervention was performed.
Main Outcome Measure: The onset of menstruation was assessed in prospectively measured menstrual cycles (311,064 cycles) over 3 full years (2019–2021). Associations were calculated between the onset of menstruation and the day of the week, and between the onset of menstruation and the lunar phase.
Results: In this large data set, a circaseptan (7-day) rhythmicity of menstruation was observed, with a peak (acrophase) of menstrual onset on Thursdays and Fridays. This circaseptan rhythm was observed in every age group, in every phase of the lunar cycle, and in all seasons. This feature was most pronounced for cycle durations between 27 and 29 days. In winter, the circaseptan rhythm was found in cycles of 27–29 days, but not in other cycle lengths. A circalunar rhythm was also statistically significant, but not as clearly defined as the circaseptan rhythm. The peak (acrophase) of the circalunar rhythm of menstrual onset varied according to the season. In addition, there was a small but statistically significant interaction between the circaseptan rhythm and the lunar cycle.
Conclusion: Although relatively small in amplitude, the weekly rhythm of menstruation was statistically significant. Menstruation occurs more often on Thursdays and Fridays than on other days of the week. This is particularly true for women whose cycles last between 27 and 29 days. Circalunar rhythmicity was also statistically significant. However, it is less pronounced than the weekly rhythm. (Fertil Steril® 2024;121:651-9. ©2023 by American Society for Reproductive Medicine.)
El resumen está disponible en Español al final del artículo.

Key Words: Menstrual cycle, menstruation, circalunar rhythm, circaseptan rhythm, circadian rhythm

Several studies have observed different frequencies of menstrual days according to the phases of the lunar cycle (1, 2). However, the influence of the moon on the menstrual cycle remains controversial (3). Studies have mostly been conducted on a small number of cycles and/or women. When statistically significant, the results have generally been criticized because of the discordance of the results, some studies showing a higher frequency of menstruation as the full moon approaches (1, 4, 5), others at another phase of the lunar cycle (6).

Several publications have reported a variation in health parameters according to the day of the week (7–11), suggesting that a weekly (circaseptan) biological rhythm may exist (12–14). On the basis of these findings, it is legitimate to think that a circaseptan rhythmicity may be involved in the menstrual cycle. Previous studies relating the lunar phases to the menstrual cycle have not evaluated for a possible circaseptan rhythm. Furthermore, it is possible that there is

Received July 27, 2023; revised December 11, 2023; accepted December 12, 2023; published online January 10, 2024.
The authors did not receive funding to support this article.
All data and materials needed to evaluate the conclusions in the article are available in the main text or the supplementary materials. Additional data related to the analysis may be requested from the authors.
Correspondence: Claude Gronfier, Ph.D., Centre de Recherche en Neurosciences de Lyon (CRNL), Neurocampus, Inserm U1028, CNRS UMR5292, Université de Lyon, Lyon, France (E-mail: claude.gronfier@inserm.fr).

Fertility and Sterility® Vol. 121, No. 4, April 2024 0015-0282

https://doi.org/10.1016/j.fertnstert.2023.12.009

an interaction between circaseptan and circalunar rhythms. This may also explain some of the discrepancy in the literature regarding the relationship between the menstrual and the lunar cycles.

The question we raise in this study is that of the interaction between external and internal factors on the menstrual cycle. First, in many animal species, fertility varies with the seasons, but this relationship remains to be clarified in women (15). Seasonal changes in photoperiod (daylight hours) could have an impact on the menstrual cycle (16). Second, the possible association between lunar phases and the menstrual cycle may depend on the length of the cycle, because a cycle of duration longer than 27 days is more closely associated with the circalunar rhythm (2). Third, it is well established that menstrual cycle length changes with age (17). What has not been systematically investigated is the possible existence of a circaseptan rhythm of the menstrual cycle.

All of these effects are expected to be small, which can lead to inconsistent results across studies, especially when studies include a small number of women and/or menstrual cycles. The current availability of large databases provides the opportunity to identify small associations or, conversely, to reject their existence with a sufficient level of certainty (18–20). Although small associations may have little immediate practical or clinical significance, understanding potential small pervasive associations can help guide research into the causes and treatments of menstrual cycle disorders.

In this study, we analyzed the timing of menstruation in a large number of menstrual cycles (>311,000) collected by women using a smartphone app (21). We studied their occurrence according to the days of the week (circaseptan rhythmicity) and to the lunar phases (circalunar rhythmicity). We investigated the influence of potential modulators such as season, age, and usual menstrual cycle length on menstrual onset within the week and within lunar phases, and we assessed their interactions.

MATERIAL AND METHODS

Women and Cycles

Menstrual cycle data were prospectively collected from women using the Natural Cycle application (NC, Stockholm, Sweden). Women were included in the data set if they met the following selection criteria: consented for their data being used for scientific research in an anonymized and aggregated form; subscribed to NC after December 31, 2018; were 18–40 years old. Exclusion criteria included known polycystic-ovarian syndrome, thyroid disease, endometriosis, and menopause. In addition, users had to have used the app for at least 3 complete cycles with a valid subscription and have reported their country and region of residence to NC. Women were asked to mark the beginning of their menstrual cycle with the first day of blood flow.

Data were collected over 3 full years in Europe and North America between 2019 and 2021. A total of 35,940 women provided 1–10 cycles (n = 26,421), 10–15 cycles (n = 4,912), or 15–48 cycles (n = 4,607), for a total of 311,064 menstrual cycles. Individual cycles were included in the data set if: the first day of menstruation (i.e., the start date of the cycle) and the first day of the next menstruation (i.e., the start date of the next cycle) had been logged by the user; pregnancy did not occur in this or previous cycles; it was not the first cycle after discontinuation of hormonal contraception and no emergency hormonal contraception was reported in this or previous cycles; there were at least 12 days with logged basal body temperature (BBT) points during the cycle and there was a maximum of 30 days between 2 logged BBT points. Cycles longer than 200 days were excluded. The selection on the number of days of temperature taking was intended to select women who were assiduous in collecting information on their menstrual cycle. We did not limit the study to ovulatory cycles.

Ethics

The research protocol of which this publication is the result has received the favorable opinion of the Ethics Committee of the University of Lyon under the number: CER-UdL no. 2023-04-06-005.

Variables

Cycle length was the number of days, from the first included day to the day before onset of the next menses. Menstrual cycles were classified into 2 categories: those whose duration is close to 28 days (including cycles of 27, 28, or 29 days), and those not close to 28 days (any other cycle length). Age was divided into 4 categories: 18–25, 26–30, 31–35, and 36–40 years.

The date of the first day of menstruation was used to identify the day of the week, lunar phase, and season. Seasons (Northern hemisphere) were defined as follows: fall (September, October, and November), winter (December, January, and February), spring (March, April, and May), and summer (June, July, and August). The lunar cycle was divided into 8 standard phases of 3–4 days each. They were identified using the *lunar* package of the R software. We took into account 2 peculiarities of the lunar cycle. First, the length of the lunar cycle is approximately 29.5 days and not 28, so the number of days per lunar phase varies. For example, the number of days per phase in the first lunar month of 2020 (starting on January 23, 2020) was New moon (n = 4), Waxing crescent (n = 4), First quarter (n = 3), Waxing gibbous (n = 4), Full moon (n = 4), Waning gibbous (n = 3), Last quarter (n = 4), and Waning crescent (n = 4). However, in the first lunar month in 2021 (beginning on January 12, 2021), it was New moon (n = 3), Waxing crescent (n = 3), First quarter (n = 4), Waxing gibbous (n = 3), Full moon (n = 4), Waning gibbous (n = 4), Last quarter (n = 4), and Waning crescent (n = 3). Second, the number of each of the weekdays in each of the lunar phases varies in each lunar month. During the first lunar month in 2020: Sunday (n = 4), Monday (n = 4), Tuesday (n = 4), Wednesday (n = 4), Thursday (n = 5), Friday (n = 5), and Saturday (n = 4). In contrast, in 2021: Sunday (n = 4), Monday (n = 4), Tuesday (n = 5), Wednesday (n = 4), Thursday (n = 4), Friday (n = 4), and Saturday (n = 3).

Statistical Analysis

The range of the frequency of the first day of menses by day of the week and by lunar phase was plotted, along with simultaneous confidence intervals for the multinomial proportions, calculated using the method of Sison and Glaz (22). Homogeneity was tested using a Pearson chi-squared test. The analysis was refined to study the impact of season, age category, cycle duration, and the lunar and/or circaseptan phases.

Under the null hypothesis of no association of weekly or circalunar rhythms with menstrual cycles, more cases would be observed for weekdays or lunar phases that included more days in the given study year. To avoid statistical bias, we applied a "density" (frequency of occurrence per day) instead of an absolute frequency, which provides a standardized measure of menstruation during a given phase (day of the week or lunar phase). Supplemental Table 1 (available online) illustrates the calculations for this standardization process.

Moreover, we had to address the fact that our data are periodic in nature. The 2 variables involved are the day of menstruation during the week and the phase of menstruation during the lunar cycle. They can be plotted on a circle, which is why those analyses are called "circular." On the circle, the measurements at 0° and 360° (in our case, the beginning and end of each week or lunar cycle) represent the same direction, whereas on a linear scale they would be located at opposite ends of a scale. For this reason, circular data require specific analytic methods (23).

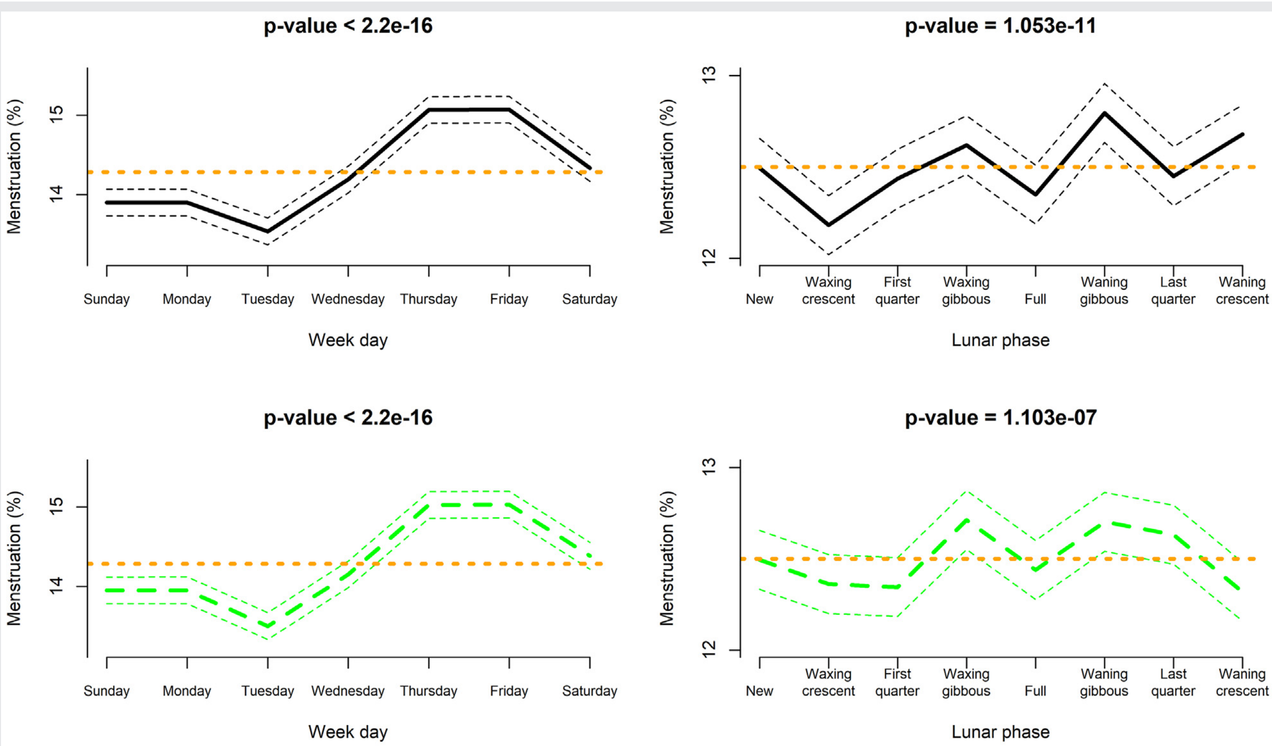
For each group (e.g., age category) of menstrual cycles, we calculated the average circular direction, i.e., the average day of menstrual onset, and the resulting Rho (the average resulting length). The latter is a statistic between 0 and 1 that indicates the concentration of the data around the mean direction. A value close to 0 indicates that the dispersion is large, whereas a value close to 1 indicates that all the data are concentrated in the mean direction. A Rayleigh test (using R's *circular* package) was used to estimate the probability of obtaining the observed data in the absence of a preferred day of menstruation simply by chance.

To test the association of factors such as season, age, or menstrual cycle length with the timing of menstruation during the week or during the lunar cycle, we used an analysis of variance for the circular data, specifically, the non-equal concentration parameter approach (using R's *directional* package). All statistical analyses were performed using the R software (R version 4.1.3, 2022-03-10, The R Foundation for Statistical Computing). A P value $<.05$ was considered for statistical significance.

RESULTS

The age of the women at study entry was 17–25, 25–30, and 30–40 years, respectively, for 5,669 (15.77%), 14,428

FIGURE 1



Circaseptan (weekday) and lunar phase occurrence of first menstrual day of on a set of 311,064 menstrual cycles from 35,940 women. The thick line represents the frequency and the dotted lines represent the 95% confidence interval. The top plots (black lines) are based on raw data. The bottom plots (green lines) are based on standardized data, as described in the Statistical Analysis section. The horizontal dotted line in orange is simply 1/7 or 1/8, respectively, representing the null hypothesis of equal frequency of menstruation on each day of the week.

Ecochard. Weekly and monthly menstrual rhythms. Fertil Steril 2024.

(40.14%), and 15,843 (44.08%) of them. Of these, 15,342 (42.69%) and 20,598 (57.31%) lived in Europe and North America, respectively.

Impact of Standardization

Although the study covers a long period (3 years), there was a slight imbalance in the distribution of the days of the week among the lunar phases (Supplemental Table 2, available online). The total number of collection days varied little by day of the week, but more significantly by lunar phase. Figure 1 shows that our standardization approach affected the lunar phases more than the circaseptan phases.

Frequency of the First Day of Menstruation during the Week (Circaseptan Rhythm)

We found a clear and highly significant ($P < 2.2E\text{-}16$) variation of the frequency of menstrual onset across the days of the week (Fig. 1). The pattern was clearly unimodal, and sigmoidal over the week. The peak occurrence (or acrophase) was clearly identified at the end of the week, over Thursday and Friday.

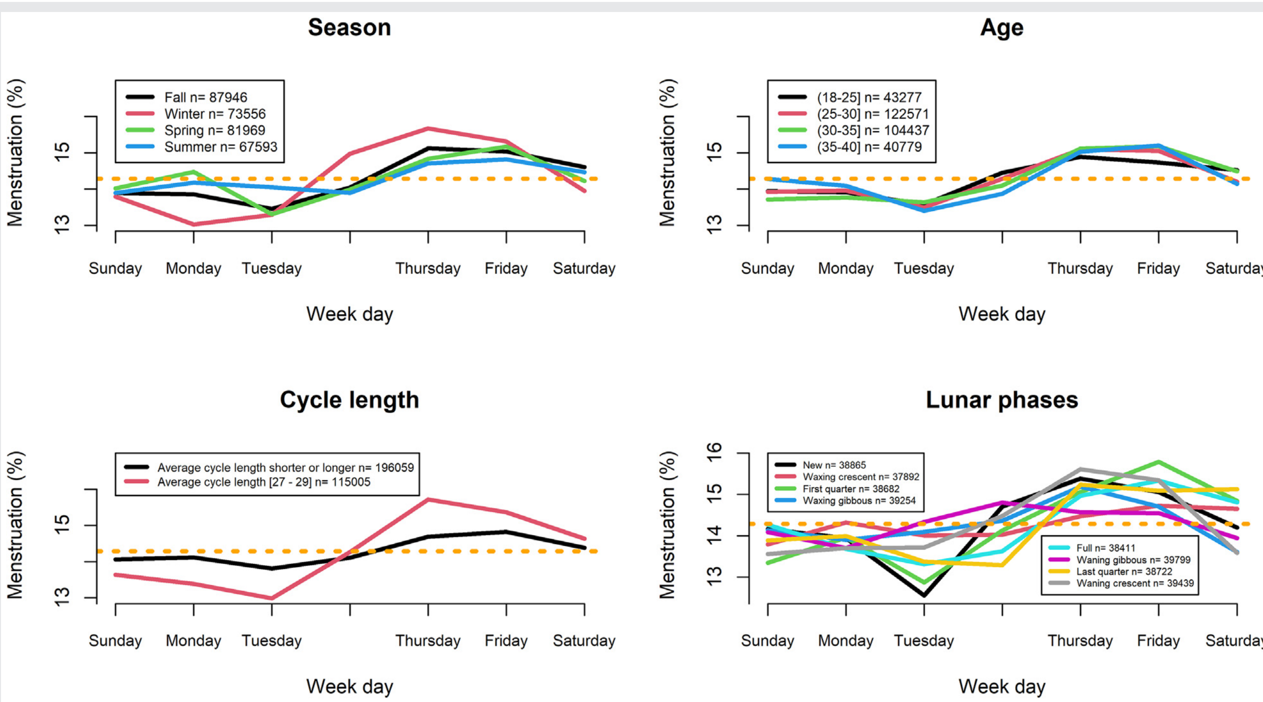
Frequency of First Day of Menstruation according to the Lunar Phases

The variation in the frequency of menstrual onset according to the lunar phases was less pronounced and less clearly unimodal (Fig. 1). The first day of menstruation occurred less frequently in the Waxing crescent and First quarter than in the Waxing, Waning gibbous, or Last quarter. Although the variation was less than for the circaseptan cycle, it was statistically significant ($P < 1E\text{-}11$).

Variation of the Circaseptan Rhythm according to the Season, Age, Length of the Cycle, and Phases of the Lunar Cycle

Univariate analyses. Figure 2 shows the effect of the factors studied on the pattern of menstrual onset by day of the week. The circaseptan rhythm of menstruation was more pronounced in winter than in the other seasons, and more pronounced for the cycles of 27–29 days than for the shorter or longer cycles. Increasing age was associated with a slight decrease in the frequency of mid-week menstrual onset. The overall distribution of the relationship between the frequency of menstrual onset and the day of the week persisted regardless of the lunar phase.

FIGURE 2



Frequency of menstruation by day of week. The horizontal dotted line in orange is simply 1/7, representing the null hypothesis of equal frequency of menstruation on each day of the week. The numbers shown are raw, but the frequencies are adjusted. The frequencies indicated by the solid lines are the standardized frequencies, i.e., per day, taking into account that the number of days of the week may vary slightly during the period considered (e.g., more Mondays in the new moon phase one year than another year).

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TABLE 1

Frequency of occurrence of the first day of menstruation according to the days of the week.

Group	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Weekday mode	Weekday mean	Rho[a]	Intra-group[b] *P* value	Inter-group[c] *P* value
Season	–	–	–	–	–	–	–	–	–	–	–	< .001
Fall	12,218 (13.89)[d]	12,180 (13.85)	11,831 (13.45)	12,345 (14.04)	13,302 (15.13)	13,225 (15.04)	12,845 (14.61)	Thursday	Friday	0.03	.001	
Spring	10,313 (14.02)	10,645 (14.47)	9,783 (13.3)	10,285 (13.98)	10,910 (14.83)	11,157 (15.17)	10,463 (14.22)	Friday	Friday	0.02	.001	
Summer	11,389 (13.89)	11,618 (14.17)	11,516 (14.05)	11,388 (13.89)	12,059 (14.71)	12,144 (14.82)	11,855 (14.46)	Friday	Friday	0.01	.001	
Winter	9,318 (13.79)	8,798 (13.02)	8,980 (13.29)	10,123 (14.98)	10,596 (15.68)	10,352 (15.32)	9,426 (13.95)	Thursday	Thursday	0.05	.001	
Age, y	–	–	–	–	–	–	–	–	–	–	–	.216
18–25	6,031 (13.94)	6,017 (13.9)	5,873 (13.57)	6,254 (14.45)	6,443 (14.89)	6,374 (14.73)	6,285 (14.52)	Thursday	Friday	0.02	.001	
25–30	17,063 (13.92)	17,100 (13.95)	16,536 (13.49)	17,508 (14.28)	18,504 (15.1)	18,454 (15.06)	17,406 (14.2)	Thursday	Friday	0.02	.001	
30–35	14,323 (13.71)	14,379 (13.77)	14,239 (13.63)	14,725 (14.1)	15,790 (15.12)	15,850 (15.18)	15,131 (14.49)	Friday	Friday	0.03	.001	
35–40	5,821 (14.27)	5,745 (14.09)	5,462 (13.39)	5,654 (13.86)	6,130 (15.03)	6,200 (15.2)	5,767 (14.14)	Friday	Friday	0.02	.001	
Cycle length	–	–	–	–	–	–	–	–	–	–	–	< .001
27–29	15,684 (13.64)	15,394 (13.39)	14,936 (12.99)	16,407 (14.27)	18,078 (15.72)	17,672 (15.37)	16,834 (14.64)	Thursday	Friday	0.05	.001	
Shorter or longer	27,566 (14.06)	27,682 (14.12)	27,074 (13.81)	27,667 (14.11)	28,803 (14.69)	29,061 (14.82)	28,206 (14.39)	Friday	Friday	0.02	.001	
Lunar phase	–	–	–	–	–	–	–	–	–	–	–	< .001
New	5,539 (14.25)	5,205 (13.39)	4,911 (12.64)	5,753 (14.8)	6,015 (15.48)	5,888 (15.15)	5,554 (14.29)	Thursday	Friday	0.04	.001	
Waxing crescent	5,156 (13.61)	5,610 (14.81)	5,486 (14.48)	5,243 (13.84)	5,152 (13.6)	5,767 (15.22)	5,478 (14.46)	Friday	Saturday	0.01	.001	
First quarter	5,228 (13.52)	5,469 (14.14)	4,814 (12.45)	5,536 (14.31)	5,900 (15.25)	6,183 (15.98)	5,552 (14.35)	Friday	Friday	0.04	.001	
Waxing gibbous	5,622 (14.32)	5,530 (14.09)	5,352 (13.63)	5,713 (14.55)	6,040 (15.39)	5,584 (14.23)	5,413 (13.79)	Thursday	Thursday	0.02	.001	
Full	5,114 (13.31)	5,150 (13.41)	5,249 (13.67)	5,376 (14)	5,635 (14.67)	6,047 (15.74)	5,840 (15.2)	Friday	Friday	0.04	.001	
Waning gibbous	5,644 (14.18)	5,491 (13.8)	5,745 (14.44)	5,932 (14.9)	5,836 (14.66)	5,564 (13.98)	5,587 (14.04)	Wednesday	Wednesday	0.01	.001	
Last quarter	5,516 (14.25)	5,558 (14.35)	5,070 (13.09)	4,799 (12.39)	6,052 (15.63)	5,993 (15.48)	5,734 (14.81)	Thursday	Friday	0.04	.001	
Waning crescent	5,419 (13.74)	5,228 (13.26)	5,483 (13.9)	5,789 (14.68)	6,237 (15.81)	5,852 (14.84)	5,431 (13.77)	Thursday	Thursday	0.04	.001	

Notes: The numbers shown are raw, as are the frequencies, the mode of distribution. However, the circular mean and the tests are calculated on standardized data according to the procedure indicated in the Statistical Analysis section of the article. All statistical tests are univariate.
[a] Rho mean resultant length.
[b] Rayleigh test.
[c] ANOVA test for circular data.
[d] Raw numbers and percentages in brackets.

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Table 1 shows the observed frequency of menstruation for each day of the week. The mode of distribution and the circular mean express the acrophase of the circaseptan rhythm. For many of the subgroups, the acrophase occurred at the end of the week (Thursday or Friday). The *P* value column for the within-group analysis was uniformly significant. This means that in each subgroup of data, for example, those concerning a season, autumn for example, the observed distribution was not compatible with simple chance, demonstrating the existence of a circaseptan rhythm of menstruation within each subgroup. The between-group ANOVA test for circular data indicates statistically significant differences in circaseptan rhythm between seasons, cycle lengths, and lunar phases. However, there was no significant difference in circaseptan rhythm between age groups.

Bivariate analyses. Supplemental Figure 1 (available online) shows that the circaseptan rhythm was shown to be more pronounced for the 27–29-day cycles than for the others, regardless of the season. During the winter months, 27–29-day cycles had the most pronounced circaseptan rhythm, even though it was also present in the other seasons as well. Supplemental Figure 2 shows that the circaseptan rhythm was more pronounced for cycles of 27–29 days than for the other cycle lengths, regardless of the woman's age.

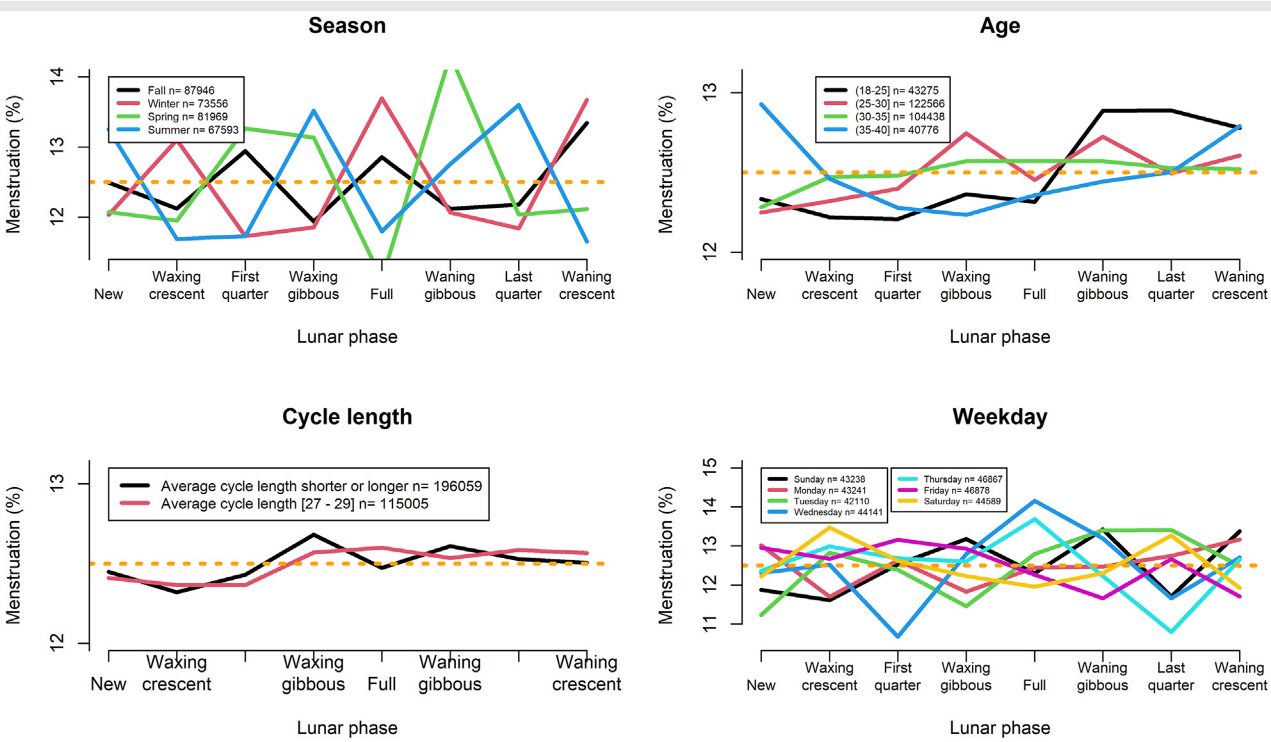
Circalunar Rhythmicity according to Season, Woman's Age, Length of the Cycle, and Phases of the Lunar Cycle

Figure 1 shows that menstruation occurred less frequently in the Waxing crescent and First quarter than in the Waxing, Waning gibbous, or Last quarter. This trend was confirmed for the 2 groups of cycle length and all age categories (Fig. 3).

The mode of the distribution was generally found during the Waning gibbous lunar phase. The circular mean was also generally found during the Waning gibbous phase, or at Full moon or during the Last quarter as shown in Supplemental Table 3 (available online). The *P* values of the Rayleigh test were significant, although the magnitude of the differences in menstrual frequency between phases was very small. The amplitude of variation in the frequency of occurrence of menstrual onset according to the lunar phase was smaller than this variation for the weekly rhythm. This translates into Rho values in Supplemental Table 3 that are approximately 3 times lower than those observed for the circaseptan rhythm in Table 1.

Moreover, Figure 3 shows remarkable variations in the circalunar rhythm of menstruation for the 4 seasons and the days of the week, but no specific pattern emerges.

FIGURE 3



Frequency of menstruation by lunar phase. The horizontal dotted line in orange is simply 1/8, representing the null hypothesis of equal frequency of menstruation on each lunar phase. The numbers shown are raw, but the frequencies indicated by the solid lines are the standardized frequencies.

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DISCUSSION

Using a large data set of women in North America and Europe, our study reveals the existence of a circaseptan rhythm of menstrual onset, with an acrophase on Thursday and Friday. This circaseptan rhythm was observed in every season, age group, and at each phase of the lunar cycle. Oscillation was most pronounced for menstrual cycles lasting between 27 and 29 days. In winter, the circaseptan rhythm was particularly pronounced for menstrual cycles of 27–29 days, but was absent for other cycle lengths. Overall, circalunar rhythmicity was much less pronounced than circaseptan rhythmicity, albeit statistically significant. We also observed an effect of season on circalunar rhythm and an interaction between circaseptan and lunar rhythms. The large sample size of the data set enabled us to obtain significant results and detect small associations, which may or may not be clinically meaningful.

The circaseptan rhythm of menstrual onset has not been observed in other studies to date (24). This may be due to the relatively small effect size: the decrease in frequency on Tuesday and the increase on Thursday and Friday vary by only a few percent, which would not appear in studies with smaller sample sizes.

Two different views have been considered to explain circaseptan rhythmicity for biological or psychological processes (25). The biological view suggests an internal mechanism for these rhythms, on the basis of the evidence that certain chemicals in urine (26), the number of erythrocytes, and the concentration of hemoglobin (27) show a weekly rhythmicity. Because circaseptan rhythms have also been observed in animals, proponents of this view have favored the possibility of such an endogenous drive (28, 29). An alternative view suggests an external mechanism driving weekly rhythms, which could be induced changes that occur between the week and the weekend and affecting physiology (30), both in real life for humans and in laboratory conditions for animals (25). One of the most common weekly rhythmicity is that of the sleep-wake cycle. Social constraints (school and work) during the week usually result in sleep episodes that are earlier and shorter during the week than during the weekend. This phenomenon, known as social jet-lag (31), is associated with a variety of health consequences, particularly in later chronotypes, and is thought to be due to both chronic sleep debt and instability of the endogenous circadian timing system. Given that sleep regulates sexual hormones in women (32), those weekly sleep and circadian changes could be involved in the circaseptan rhythmicity of the menstrual cycle we describe in this study. In addition, because changes in sleep duration and circadian timing of sleep modify the light-dark cycle to which individuals are exposed, it is also possible that a weekly rhythm of light exposure acts as a modulator of menstrual circaseptan rhythmicity. Indeed, the effects of light on the menstrual cycle have been well described (33–36) and could be a key modulator of a circaseptan rhythmicity.

The highly significant relationship between circaseptan rhythmicity and menstrual cycle length may be a result of the impact of daily life (e.g., a work schedule) on the menstrual cycle. This could also be the consequence of a link between daily life and a biological clock of period close to 7 days, or 4 weeks of 7 days (28 days). The existence of an internal clock with a rhythm close to 7 days has been proposed by several investigators reporting the existence of circaseptan rhythm in other fields (12–14). In winter, the greater circaseptan rhythm for cycles of approximately 28 days, and the quasi-absence of a weekly rhythm for cycles of other durations, raises the question of what could explain the interaction between season and the weekly rhythm of the menstrual cycle. A more pronounced presence of circaseptan rhythms in the winter has been observed in mental disorders (28). The investigators suggested that this was an argument in favor of an external origin of this rhythm, rather than the existence of an internal clock. Although we do not reject that hypothesis, we could argue that it does not invalidate the alternative hypothesis of an endogenous clock-like mechanism, because seasonal rhythmicity is thought to relate to clock-based mechanisms (circadian/circannual) that are modulated by photoperiod (37, 38). In our results, that in winter, the circaseptan rhythm was particularly pronounced for cycles of 27–29 days, but almost absent for cycles of other lengths suggests a possible link between the circaseptan rhythm and a circamonthly cycle close to 28 days.

The results concerning the circalunar menstrual rhythm are statistically significant in the whole data set and in each of the subgroups studied. However, it was less easy to interpret than the circaseptan rhythm. The circalunar rhythm did not vary with cycle lengths. There was a small predominance of menstruation during the phases around the full moon, as observed by other investigators (1, 2). Overall, our results confirm the association between the menstrual cycle and the lunar cycle and, although the strength of association is smaller compared with that with the circaseptan rhythm.

One limitation of our data is that some women may experience premenstrual spotting, which might shift the perceived onset of menses. However, the incidence of premenstrual spotting may be approximately 10%, and we believe that this should not have a strong impact on our analysis (39). Our sample may not be representative of the general population, in particular because of the self-selection of women using an application to record the progress of their menstrual cycle. The sociodemographic characteristics of our sample do not represent the distribution of the general population: among those who choose to indicate it in the application, a large majority identified as Non-Hispanic White, and reported having obtained a university or a doctoral degree. However, it does not appear that this could lead to a bias in terms of the day of menstruation.

What are the advantages of knowing that menstrual cycles are affected by the weekly rhythm and are not independent of the lunar rhythm? This question is related to that of the impact of professional activity, sleep, light, and even pollution on human biology. This not only opens up new avenues for preventing dysovulation, but also for therapies such as chronotherapy and/or light therapy.

Future studies should consider whether an earlier or later onset of menstruation is related to the follicular phase or the luteal phase of the menstrual cycle, and their associated hormonal variations. Higher progesterone levels after ovulation make the body temperature rise by approximately 0.5°F. Because the app we used records BBT, the luteal phase could be analyzed in a future study on this data set.

CONCLUSIONS

Although of low amplitude, a circaseptan rhythm of menstrual onset is clearly present in this large data set. This rhythm is most prominent for cycles lasting 27–29 days, and seems to be influenced by the season. A circalunar rhythmicity, of lesser amplitude and perhaps of greater variability according to season or age, seems to be present as well. An interaction between these circaseptan and circalunar rhythms is found, which requires further study.

Acknowledgments

The authors thank the tens of thousands of women who shared their data with us.

CRediT Authorship Contribution Statement

René Ecochard: Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Data curation, Conceptualization. **Rene Leiva:** Writing – review & editing. **Thomas P. Bouchard:** Writing – review & editing. **Agathe Van Lamsweerde:** Writing – review & editing, Software, Investigation, Data curation. **Jack T. Pearson:** Writing – review & editing, Software, Investigation, Data curation. **Joseph B. Stanford:** Writing – review & editing. **Claude Gronfier:** Writing – review & editing, Validation, Supervision, Methodology.

Declaration of Interests

R.E. has nothing to disclose. R.L. has nothing to disclose. T.P.B. has nothing to disclose. A.V.L. has nothing to disclose. J.T.P. has nothing to disclose. J.B.S. has nothing to disclose. C.G. has nothing to disclose.

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El ciclo menstrual está influenciado por los ritmos semanales y lunares

Objetivo: Estudiar si el ciclo menstrual tiene un ritmo circaseptano (7 días) y si está asociado al ciclo lunar (también definido como mes sinódico, es el ciclo de las fases de la Luna vista desde la Tierra, con un promedio de 29.5 días de duración).

Diseño: Estudio transversal.

Sujetos: Un total de 35,940 mujeres Europeas y Norteamericanas de entre 18 y 40 años.

Exposición: Los datos se recopilaron en condiciones de la vida real.

Intervención: No se realizó ninguna intervención.

Principal medida de resultado: el inicio de la menstruación se evaluó en ciclos menstruales medidos prospectivamente (311,064 ciclos) durante 3 años completos (2019-2021). Se calcularon asociaciones entre el inicio de la menstruación y el día de la semana, y entre el inicio de la menstruación y la fase lunar.

Resultados: En este gran conjunto de datos, se observó una ritmicidad circaseptana (7 días) de la menstruación, con un pico (acrofase) de inicio menstrual los jueves y viernes. Este ritmo circaseptano se observó en todos los grupos de edad, en todas las fases del ciclo lunar y en todas las estaciones. Esta característica fue más pronunciada para ciclos con duraciones de entre 27 y 29 días. En invierno, el ritmo circaseptano se encontró en ciclos de 27 a 29 días, pero no en ciclos de otras duraciones. Un ritmo circalunar también fue estadísticamente significativo, pero no tan claramente definido como el ritmo circaseptano. El pico (acrofase) del ritmo circalunar de inicio menstrual varió según la estación. Además, hubo una interacción pequeña pero estadísticamente significativa entre el ritmo circaseptano y el ciclo lunar.

Conclusión: Aunque relativamente pequeño en amplitud, el ritmo semanal de la menstruación fue estadísticamente significativo. La menstruación ocurre con más frecuencia los jueves y viernes que otros días de la semana. Esto es particularmente cierto para las mujeres cuyos ciclos duran entre 27 y 29 días. La ritmicidad circalunar también fue estadísticamente significativa. Sin embargo, es menos pronunciado que el ritmo semanal.