Review

Living Cyclically: Exploring the Science Behind Hormonal Shifts, Lunar Influence, and Metabolic Changes in Women

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Living Cyclically: Exploring the Science Behind Hormonal Shifts, Lunar Influence, and Metabolic Changes in Women

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Abstract

Women often notice monthly shifts in energy, mood, and appetite, prompting questions about whether lunar phases also play a role. This paper synthesizes current literature to explore how menstrual cycle–driven hormonal fluctuations—particularly shifts in estrogen and progesterone—affect macronutrient metabolism, cravings, and exercise performance, with a focus on increased appetite and subtle performance variations in the luteal phase. It further examines evidence for potential lunar effects, including studies suggesting modest correlations between moon phases, menstrual onset timing, and sleep disruptions, even though modern lifestyles often obscure such rhythms. For those who do not menstruate—such as postmenopausal women—adopting a monthly or "lunar" framework may still help address cyclical changes in mood or energy. Practical recommendations highlight "cycle syncing" via chrononutrition (aligned meal timing and composition) and targeted exercise based on hormonal states, while also acknowledging debates around any direct lunar impact. Ultimately, emerging findings emphasize the importance of personalized tracking, and future research with rigorous hormonal verification and sleep monitoring is needed to clarify the extent to which lunar considerations enhance health outcomes.

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It is well-established that many women experience fluctuations in energy levels, mood, and appetite throughout the menstrual cycle (MC). Although commonly described as lasting 28 days, actual cycles frequently vary from 21 to 35 days (Carmichael et al., 2021). The MC comprises two main phases: follicular, from the start of menstruation until ovulation, and luteal, spanning from ovulation until the next menses (Dye & Blundell, 1997). Estrogen and progesterone oscillations during these phases substantially influence metabolism, appetite regulation, and overall mood, contributing to individual variability in nutritional and performance outcomes.

Beyond these hormonal variations, there is a longstanding cultural and historical belief linking the Moon's approximately 29.5-day cycle with women's reproductive rhythms (Jones, 2024). While modern science yields mixed findings regarding a formal lunar-menstrual alignment, anecdotal reports persist of monthly changes—both among menstruating and non-menstruating women—that correspond loosely to lunar phases (Wehr & Helfrich-Förster, 2021). As a result, questions arise about whether adopting a cycle-based or lunar-based framework can optimize diet, training, and well-being across diverse life stages.

Although menstrual phases are widely recognized for their impact on metabolism, cravings, and exercise potential, the role of lunar rhythms remains comparatively unexamined. For individuals who no longer menstruate—such as those in menopause—monthly shifts in mood and energy might still occur but lack tailored guidance. Although a 28–29.5-day "rhythm" approach might benefit these populations, little research addresses how both biological (hormonal) and environmental (lunar) cues can be integrated into practical, individualized nutrition and exercise strategies.

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Research suggests that the lunar cycle may subtly influence menstrual timing and sleep (Helfrich-Förster et al., 2021; Wehr & Helfrich-Förster, 2021). While modern factors, such as artificial lighting or irregular schedules, may mask ancestral lunar connections, these hints imply that chrononutrition approaches, which align meal timing and exercise with hormonal and possibly lunar rhythms, could refine women's health practices. Potential benefits include weight management, improved athletic performance, and enhanced mood/energy, emphasizing the need for a more personalized nutritional framework for menstruating and non-menstruating women.

This paper seeks to respond to the **research question**: *How do fluctuations in menstrual cycle phases and lunar cycles impact women's macronutrient metabolism, cravings, and energy utilization, and what evidence-based strategies can optimize hormonal balance and performance?* In doing so, it (1) provides background on menstrual and lunar cycles; (2) synthesizes research findings on metabolic, hormonal, and performance changes; (3) addresses gaps and limitations; and (4) concludes with practice recommendations and future research directions.

Menstrual Cycle and Metabolism

Overview of the Menstrual Cycle (MC)

The MC is often broken into follicular and luteal phases (Carmichael et al., 2021). In the follicular phase, rising estrogen and relatively low progesterone typically enhance insulin sensitivity and may slightly suppress appetite (Dye & Blundell, 1997). Following ovulation, progesterone peaks in the luteal phase, often increasing resting metabolic rate and contributing to premenstrual cravings or mood changes (Benton et al., 2020). Not all women experience large swings; variability in hormone sensitivity means some notice minimal changes, while others report marked shifts in cravings, fluid retention, and overall energy.

Macronutrient Metabolism and Cravings

During the luteal phase, progesterone and decreased estrogen levels often provoke carbohydrate cravings and a mild uptick in caloric intake (Dye & Blundell, 1997). Heightened emotional reactivity in the late luteal phase can also encourage "comfort food" consumption. Conversely, the follicular phase often features better insulin sensitivity and stable energy, potentially facilitating higher-intensity training or more consistent eating patterns (Carmichael et al., 2021). Understanding these patterns can inform targeted nutrition strategies, such as increasing complex carbohydrates and protein sources before or during times of peak cravings.

Performance and Training Implications

Beyond shaping appetite and cravings, menstrual cycle hormones can also influence exercise performance, recovery, and training adaptations. McNulty et al. (2020) conducted a meta-analysis revealing predominantly trivial or small differences in performance across the cycle, though individual variability was often substantial. In practice, this means some women may detect meaningful performance dips or gains depending on their menstrual phase, while others experience negligible effects. Factors such as the type of sport, training intensity, and personal hormone sensitivity appear to play critical roles in these divergent outcomes.

One area receiving increased attention is how to optimize resistance training according to cyclical hormone peaks. Sung et al. (2014) reported that women who concentrated a greater volume of strength training sessions in their follicular phase gained more strength and muscle mass than when those same sessions were scheduled predominantly in the luteal phase. The authors attribute this difference partly to higher estrogen-to-progesterone ratios, as estrogen can enhance muscle protein synthesis and potentially interact with testosterone levels. These findings suggest that, for athletes or highly active women, modifying training loads based on the menstrual cycle might yield

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performance benefits, especially around ovulation, when estrogen is elevated, and recovery from intense exercise may be more efficient.

Despite these encouraging data, some researchers have observed no substantial menstrual-phase–related effect on performance metrics like VO2 max, time-to-exhaustion, or anaerobic power (McNulty et al., 2020). Consequently, blanket prescriptions to alter training or competition schedules for all women may be premature. Instead, experts increasingly advocate individualized monitoring, advising female athletes and their coaches to track personal performance trends alongside menstrual cycle data. If a woman notices consistent drops (or peaks) in energy, focus, or strength at certain cycle times, periodizing workouts accordingly becomes a practical, evidence-informed strategy.

Mechanistic Underpinnings

From a biochemical standpoint, monthly changes in estrogen and progesterone do more than just shift appetite or exercise capacity; they can also impact neurotransmitter balance, thermoregulation, and stress responses. Dye and Blundell (1997) discuss how ovarian steroids may modulate serotonin and dopamine levels, which can reinforce emotional eating patterns or exacerbate mood swings, particularly in the late luteal phase.

Thermoregulatory changes further illustrate the cycle's complexity: after ovulation, progesterone increases core body temperature by approximately 0.3–0.5°C (De Jonge, 2003). While such a rise might be barely noticeable at rest, it can become significant during sustained exercise, particularly in hot and humid conditions. Women in the luteal phase may find themselves more quickly approaching critical heat limits or experiencing higher perceived exertion than they do in the follicular phase. This effect can translate into slight disadvantages during endurance events if ambient temperatures are high—although, again, the real-world impact varies widely among individuals.

Finally, these hormonal dynamics are deeply interconnected with mood and stress reactivity. Increases in progesterone are sometimes associated with heightened sympathetic activity (i.e., "fight-or-flight" responses), which can influence everything from perceived fatigue to muscle tension. Conversely, estrogen may bolster resilience to physical stress by promoting better glucose metabolism, thus potentially supporting more demanding workouts around mid-cycle (Sung et al., 2014). Taken as a whole, these interconnected mechanisms underscore why a cycle-aware approach—one that acknowledges appetite changes, thermal tolerance, mood, and recovery needs—can be invaluable in optimizing both everyday dietary choices and structured exercise programs.

Lunar Cycles and Human Physiology

Historical and Cultural Background

Throughout history, the near alignment of the average MC (~28 days) and the lunar cycle (~29.5 days) has spurred cultural beliefs, myths, and practices linking the Moon to women's fertility and emotions (Cutler et al., 1987). Deities such as Artemis, Luna, and Isis symbolize this longstanding fascination, and some women today engage in "moon charting," reporting alignment of their cycles with lunar phases, especially near the full moon. However, despite widespread anecdotal accounts, the scientific community remains skeptical about a direct physiological connection, and definitive evidence supporting a causal lunar-menstrual link is lacking.

Evidence for Lunar Influence

Recent research hints at weak yet significant alignments between menstrual onset and lunar phases—especially for women with cycles near 27–29 days (Ecochard et al., 2024; Helfrich-Förster et al., 2021). While these patterns can appear intermittently, factors like artificial light, inconsistent sleep, and varying work schedules may disrupt ancestral "circalunar" rhythms (Wehr & Helfrich-Förster,

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2021). Some laboratory studies note poorer sleep quality or altered melatonin near the full moon, which could indirectly exacerbate cravings or mood fluctuations (Cajochen et al., 2013).

Sleep, Cravings, and Mood

In addition to menstrual alignment, lunar phases also appear to influence human sleep, mood, and possibly appetite. Komada et al. (2021) found that menstruation aligned with darker moon phases correlated with poorer sleep quality. Furthermore, laboratory-based experiments conducted by Cajochen et al. (2013) found that, even without direct exposure to moonlight, sleep patterns were altered near full moons, with individuals experiencing longer sleep latency (+5 minutes), reduced total sleep duration (−20 minutes), diminished deep NREM sleep (−30%), and lower evening melatonin levels. Reduced melatonin around the full moon could lead to increased cortisol and appetite, potentially exacerbating existing hormonal fluctuations in appetite or cravings, particularly in susceptible individuals (Cajochen et al., 2013).

These lunar-linked sleep disruptions and their physiological consequences find broader support in earlier literature reviewed by Mandal (2023). His analysis highlights consistent findings of increased hospital admissions for cardiovascular emergencies, gastrointestinal issues, and urinary retention associated with specific lunar phases. These effects could be mediated by subtle hormonal changes involving melatonin and stress-related steroids, which respond sensitively to environmental rhythms, including moon phases (Mandal, 2023).

Potential Mechanisms of Lunar Effects

Researchers have proposed that lunar cues act like circadian "zeitgebers," subtly synchronizing internal clocks. Although gravitational forces seem too weak to cause major changes, minor shifts in atmospheric pressure or Earth's electromagnetic field may still influence hormonal pathways (Wehr & Helfrich-Förster, 2021). Moonlight-induced modulation of melatonin is a key factor: even without direct moonlight exposure, participants in lab settings have shown altered sleep patterns near the full moon, suggesting residual "circalunar" rhythms (Cajochen et al., 2013). In animal studies, melatonin, steroid hormones, and immune function fluctuate in response to moon phases, reflecting an evolutionarily conserved sensitivity (Mandal, 2023). For humans, such subtle hormonal shifts could affect reproductive timing, sleep, and mood—though modern lighting, varied sleep schedules, and individual differences often confound findings.

Critiques and Limitations

Many lunar-based findings rely on retrospective app data or large but nonrepresentative samples. Methodological pitfalls include inconsistent reporting of menstrual onset, minimal hormone verification, and lack of control for artificial light (Ecochard et al., 2024). Some large-scale studies find no significant lunar effects on menstruation or birth rates (Mandal, 2023), underscoring that any moon influence is likely subtle and easily overshadowed by modern lifestyles (Helfrich-Förster et al., 2021).

Integrating Menstrual and Lunar Cycles: A Chrononutrition Perspective

Chronobiology and Women's Health

Chronobiology focuses on natural physiological rhythms, such as circadian (24-hour) and circalunar (~29.5-day) cycles, to optimize health (Garaulet & Gómez-Abellán, 2013). Disruption of these rhythms—whether by shift work, late-night eating, or inconsistent light exposure—can elevate risks for metabolic issues (Manoogian & Panda, 2017). A chrononutrition approach suggests aligning meal timing, exercise, and sleep with innate hormonal patterns to improve outcomes.

Cycle Syncing

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A practical and emerging method of honoring both daily and monthly cycles is cycle syncing, which entails adjusting diet, exercise, and lifestyle habits according to menstrual phases (Cleveland Clinic, 2023; Gunther, 2023). This approach is premised on the idea that fluctuations in hormones—estrogen, progesterone, testosterone—across the MC significantly affect mood, energy levels, sleep, and appetite.

Cycle syncing strategies typically divide the MC into four phases:

- **Menstrual Phase (Days 1–7)**: Energy and estrogen levels dip significantly; cravings and fatigue rise. Recommendations include iron-rich foods (e.g., leafy greens, lean red meat, lentils) and gentle restorative activities. Vitamin C intake aids iron absorption and supports overall vitality (Gunther, 2023).
- **Follicular Phase (~Days 8–13):** Rising estrogen enhances insulin sensitivity and workout intensity potential. Nutrition should emphasize lean proteins, complex carbohydrates, and estrogen-balancing foods like cruciferous vegetables and fermented foods, aligning carbohydrate timing around training sessions (Cleveland Clinic, 2023; Gunther, 2023).
- **Ovulation (~Days 14–15):** High estrogen and testosterone provide peak energy suited for more demanding exercise. Balanced, nutrient-rich meals maintain energy and endurance capacity (Cleveland Clinic, 2023).
- **Luteal Phase (~Days 16–28):** Increased progesterone is often accompanied by cravings, mood shifts, and disrupted sleep patterns. Strategically timed complex carbohydrates (e.g., sweet potatoes, whole grains), magnesium-rich foods (e.g., pumpkin seeds), adequate hydration, and mindfulness practices around food intake help stabilize mood, energy, and appetite (Cleveland Clinic, 2023; Gunther, 2023). Additionally, higher caloric intake—commonly ~200-350 kcal/day higher during this phase—reflects natural physiological demands, particularly for active or athletic women (Gunther, 2023).

Some practitioners incorporate lunar phases into these adjustments (Kadlubar, 2024; Sutherland, n.d.). For example, a woman might plan restorative practices if her late luteal phase coincides with full moon–related sleep disruption. Although compelling, such blended approaches are mainly anecdotal or observational. Rigorous trials are needed to determine if lunar alignment confers additional benefits beyond MC syncing alone.

Practical Applications

- Meal Timing: An 8–12 hour daily eating window (time-restricted feeding) may reinforce circadian rhythms (Manoogian & Panda, 2017).
- Tracking Tools: Apps (e.g., "Moonchild") can log both menstrual and lunar data, enabling personalized observations of cravings or moods.
- Personalization: Hormonal contraceptives, irregular cycles, or menopause alter endogenous rhythms. Logging subjective symptoms may reveal whether one's body reacts to perceived lunar cues.

Gaps and Limitations

Most studies on cyclical fluctuations focus on healthy, regularly cycling women ages 18–35. Underrepresented populations—such as those in perimenopause, menopause, or with irregular cycles—remain understudied (Helfrich-Förster et al., 2021). Additionally, many investigations rely on calendar-based estimates rather than hormone assays, potentially obscuring phase verification (Ecochard et al., 2024). Large-scale data sets derived from menstrual apps often suffer from self-selection biases and inconsistent definitions (Komada et al., 2021).

Regarding lunar influences, confounding factors such as artificial lighting, shift work, and diverse cultural practices complicate the data (Mandal, 2023). Short study durations (one or two cycles) further limit clarity on whether observed patterns persist over time. While certain women notice significant cyclical changes, many do not, emphasizing the individualized nature of hormonal and potential lunar rhythms.

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Summary of Findings

The literature strongly indicates that menstrual cycle (MC) phases can influence appetite, macronutrient metabolism, and exercise performance. Notably, some women experience better insulin sensitivity, increased energy, and stable mood during the follicular phase, potentially allowing more intense training sessions. In contrast, the luteal phase is commonly associated with heightened cravings, slightly elevated resting metabolic rate (RMR) and temperature, and possible fluid retention.

By comparison, evidence for lunar rhythm effects in contemporary populations is modest and inconsistent. While certain studies (Ecochard et al., 2024; Helfrich-Förster et al., 2021) document small alignments between menstrual onset and full or new moons, modern life—marked by artificial lighting and irregular sleep—may mask any stronger ancestral patterns. That said, minor disruptions to sleep near full moons can compound late-luteal phase mood swings or cravings for some women.

For non-menstruating individuals, including postmenopausal women or those who have undergone a hysterectomy, adopting a 28- to 29-day schedule aligned with lunar phases might provide structural benefits for planning diet and exercise regimens. However, direct empirical support for lunar-guided interventions is scarce. Overall, existing findings highlight the critical role of *personalization*: hormonal responsiveness varies substantially from one woman to another and adjusting nutritional and training recommendations to reflect individual patterns often yields the most practical and beneficial outcomes.

Conclusion

Integrating insights on menstrual phases and possible lunar patterns suggests that while hormonal fluctuations consistently influence appetite, energy, and performance, lunar effects remain more speculative under modern lifestyles. Nonetheless, certain individuals may observe subtle changes correlating with the Moon's phases—particularly around full moons and late-luteal windows.

The key takeaway is that personalization remains paramount. Each woman's hormonal profile and lifestyle differ, meaning strategies that work well for one person to mitigate premenstrual food cravings, improve sleep, or maximize workout gains may be less effective for another. Whether someone strongly perceives cyclical variations or not, self-monitoring can inform nutrition and training strategies that honor personal hormonal cues. Integrating chrononutrition principles—consistent meal windows, cycle-aware workout scheduling, and mindful evening routines—may reduce metabolic disruptions and improve overall well-being. Larger, more rigorous studies are needed to verify if blending lunar alignment into menstrual-based approaches yields additional clinical or practical benefits.

Practice Recommendations

1. Nutritional Strategies by Menstrual (or Lunar) Phase

During the follicular phase (or a new-moon parallel), many women benefit from slightly increased carbohydrate intake to support higher-intensity workouts and leverage improved insulin sensitivity. Emphasizing nutrient-dense complex carbohydrates, lean proteins, and healthy fats can help sustain energy. In contrast, if the luteal phase (or a full-moon parallel) brings stronger cravings or fluid retention, a planned increase of approximately 100–200 daily kilocalories—preferably from protein- and fiber-rich sources—may help maintain satiety without leading to excessive caloric surplus. However, some women will experience only subtle changes in appetite; journaling or logging symptoms is often the best way to decide if increased intake is truly needed.

2. Addressing Lunar-Linked Sleep and Cravings

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Although data on pronounced lunar effects remain mixed, some women do report slight upticks in cravings or sleep disruption near the full moon. Maintaining consistent sleep hygiene—such as a regular bedtime and minimal screen use before lights out—can mitigate these fluctuations. If persistent late-night hunger or insomnia occurs, small protein-based evening snacks (e.g., cottage cheese, yogurt with berries) may help stabilize blood glucose. Practices like magnesium supplementation or guided relaxation can be considered (with medical advice) if restlessness is notably tied to late-luteal or full-moon phases.

3. Chrononutrition and Meal Timing

Encouraging a stable 10–12-hour eating window, aligned with daytime hours, supports healthy circadian function and may reduce late-night calorie consumption, which can exacerbate cravings. Women experiencing cyclical drops in energy can fine-tune their meal timing around workouts, prioritizing protein and complex carbohydrates when physical demands are highest. Adjusting dinner time or the composition of evening meals in the late luteal phase could mitigate sleep disturbances aggravated by hormonal and potential lunar factors.

4. Exercise and Performance Training

Women can personalize training cycles according to perceived hormonal shifts, potentially placing heavier resistance training or higher-intensity cardio when estrogen levels are higher and energy is steadier—often mid-follicular phase, during ovulation, and mid-luteal phase. If sleep or mood disturbances coincide with the luteal phase or full moon, gentler workouts (e.g., yoga, stretching, moderate cardio) may help decrease stress, improve recovery, and reduce perceived fatigue. Keeping a detailed training log—recording subjective measures of fatigue, motivation, and mood—can guide ongoing refinement of workout schedules and intensities.

5. Utilizing the "Moonchild" App for Personalization

For those seeking a user-friendly tool to track symptoms, moods, and daily behaviors in tandem with both menstrual and lunar cycles, the *Moonchild* app offers a comprehensive platform. It allows users to:

- Log cycle dates and symptoms such as cramps, bloating, and cravings.
- Monitor shifts in mood or energy levels corresponding to lunar phases.
- Record daily sleep quality and exercise routines.
- View trends and receive periodic reminders for nutrition, hydration, or workout adjustments.

By combining personalized journaling (via apps such as Moonchild) with fundamental strategies in nutrition, meal timing, and exercise periodization, women can better adapt their daily habits to natural cycles. This approach empowers individuals to respond proactively to cyclical hormonal and (possibly) lunar changes, ultimately supporting more consistent energy, mood, and overall health.

Future Research

Large-Scale, Multi-Cycle Studies

Incorporate validated hormone verification (e.g., serum estradiol, progesterone) alongside actigraphic sleep monitoring to track how moon phases might intersect with menstrual timing. Enrolling diverse groups, including women with irregular cycles, perimenopausal participants, and those living in low-light environments (e.g., rural areas without extensive electric lighting), would expand generalizability.

Interventional Trials

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Investigate whether structured "cycle syncing" or "lunar-based" meal/exercise plans offer tangible benefits in metabolic biomarkers, body composition, athletic performance, or sleep quality over several months. Randomized designs comparing a lunar-phase intervention with a conventional 28-day approach would clarify if "moon alignment" adds value.

Mechanistic Studies

Further research is warranted on how potential moon-related cues—light intensity, gravitational fields—may or may not affect neuroendocrine pathways (melatonin, cortisol) and peripheral tissue clocks (muscle, adipose). Clarifying these biological mechanisms would inform whether and how lunar phases meaningfully interact with menstrual hormone cycles.

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