Menstrual Cycle Health Effects on Productivity in Male-dominated Fields: A Narrative Review

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Abstract

While there is increasing awareness around gender diversity in construction health and safety, there is limited research examining the influence of different menstrual cycle phases on workplace productivity. Understanding the impact of the menstrual cycle on women's health, safety, and productivity is necessary to formulate appropriate occupational policies and support systems in physically demanding work, such as construction. This narrative review synthesises existing literature examining the relationship between menstrual cycle phases and workplace productivity and discusses implications for the construction industry. The review analysed 40 peer-reviewed publications from 2008-2024, identified through systematic database searches. Findings reveal that menstrual cycle phases can influence physical and cognitive performance through multiple mechanisms, including hormonal effects on strength, endurance, memory, and emotional processing. While direct research in construction settings is limited, evidence from related fields suggests that hormonal fluctuations may affect work performance through various pathways, including changes in dopamine regulation, brain connectivity, and physical capabilities. The review identified significant gaps in current understanding, particularly regarding construction-specific impacts and long-term effects.

Keywords

Construction, Productivity, Women's Health and Safety.

1 Introduction

Women are underrepresented in the construction industry- one of the most gender-segregated sectors in the world, making up only 14% of the workforce in most countries (Navarro-Astor et al., 2017; Oo et al., 2020; Akinlolu et al., 2020). Despite initiatives to raise gender diversity and inclusion in construction, workplace environments and policies still cater to conventional male-dominated paradigms (Galea et al., 2015). The extent of this systemic oversight has resulted in considerable deficiencies in knowledge and understanding in examining and addressing health and safety determinants unique to women's work productivity and health and well-being (Messing et al., 2009; Avilés-Palacios et al., 2013).

A critical yet largely unexplored aspect of workplace health in construction is the influence of the menstrual cycle on productivity and performance. Although studies have demonstrated that the



menstrual cycle hormonal changes can influence physical performance, cognition, and emotions (Song et al., 2022; Haryanti & Legiran, 2023), these considerations remain notably absent from construction industry workplace policies and safety protocols. This gap is especially significant considering the physical nature of construction work and its atypical occupational hazards (Botha & Cronjé, 2015). This intersection of menstrual health and workplace productivity is an important field of inquiry, particularly as the construction industry strives to tackle gender imbalance while maximising worker's performance. Traditional approaches to construction productivity have explored mechanical efficiency, technical skills, and physical capabilities from a male-centric viewpoint (Lingard & Francis, 2021). Nevertheless, while the industry is moving toward more inclusive practices, the need to understand and accommodate biological factors affecting women in the workplace and their performance outcomes is growing (Ihsan et al., 2023).

Recent research in other male-dominated sectors has started recognising the need to incorporate menstrual health into workplace design and policy development. However, the construction sector's unique physical demands, safety needs, and environmental conditions warrant a more targeted look at how the phases of women's menstrual cycle interact with factors such as worksite productivity and safety measures. The relationships among these factors are fundamental to developing evidenceinformed interventions to enable women's full participation and performance in construction-related careers.

The complexity of this topic extends beyond simple biological considerations to encompass broader social and organisational factors. This limited awareness of women's health and safety needs influences workplace cultures, physical infrastructure, and management practices in construction, resulting in barriers to performance and career advancement (Akinlolu et al., 2020). Such a knowledge gap may also be related to increased turnover rates for female construction workers, potentially widening gender gaps and inequalities in the industry (Navarro-Astor et al., 2017).

This narrative review addresses these critical knowledge gaps by synthesising published research on menstrual cycle effects on workplace productivity, particularly concerning implications and applications for the construction industry. Drawing on evidence already available from similar highdemand physical occupations and insights from across several disciplines, this review aims to provide an overarching framework to understand the impact of menstrual cycle phases on construction work environment productivity. Such knowledge is crucial for creating workplace policies and interventions that can better support women in participating in and thriving without compromising on expectations of productivity and safety (Lingard et al., 2019).

2 Literature Review

2.1 Menstrual Cycle Physiology

The menstrual cycle is a physiological process regulated by a complex interaction of the hormones and other organs of the body, such as the hypothalamus, pituitary gland, ovaries, and uterus (Song et al., 2022; Haryanti & Legiran, 2023). The menstrual cycle length generally ranges from 25 to 30 days and is described as eumenorrheic (Ihsan et al., 2023; Okoth et al., 2023). The menstrual cycle is typically divided into six sub-phases: early follicular, late follicular, ovulatory, early luteal, mid-luteal and late luteal phases (Pitchers & Elliot-Sale, 2019). As shown in Figure 1, each sub-phase is characterised by fluctuations in sex hormones and specific physiological events.

The early follicular phase commences with the onset of menstruation and represents day 1 of the cycle. In this phase, the levels of the Follicle-stimulating hormone (FSH) rise, resulting in the development of follicles in the ovaries and low levels of estrogen and progesterone (Pereira et al., 2017; Mulligan



et al., 2019). The late follicular phase, also known as a rise, characterises the preovulatory phase in estrogen levels, leading to a rapid surge in luteinising hormone (LH) that triggers ovulation (Shagawa et al., 2021).



Figure 1: Schematic displaying the hormonal fluctuations across a 28-day menstrual cycle, Adapted from Pitchers and Elliot-Sale (2019)

The ovulatory phase occurs when the mature follicle ruptures and releases the egg into the uterus (Shagawa et al., 2021). During this time, estrogen and LH levels are at their peak. Following ovulation, the early luteal phase begins with the formation of the corpus luteum from the ruptured follicle and a rise in progesterone and estrogen levels (Kozai et al., 2014). Progesterone and estrogen are highest in the mid-luteal phase (Mulligan et al., 2019), at which point a pregnancy is determined and conception is either successful or not. In the late luteal phase, progesterone and estrogen levels begin to decline due to the degeneration of the corpus luteum (Kozai et al., 2014). The luteal phase is linked to premenstrual symptoms, including mood fluctuations and physical discomfort (Farris et al., 2018; Baker et al., 2008). Hormone levels fluctuate cyclically throughout the menstrual cycle, ultimately driving the oocyte's development and release and the uterine lining's preparation and shedding (Mulligan et al., 2019). The orientation of this hormonal triad may be disrupted, leading to menstrual cycle alterations associated with many health outcomes (Okoth et al., 2023).

2.2 Proposed Mechanisms Behind Menstrual Cycle-Based Changes in Productivity

There is a dearth of research on the proposed mechanisms behind menstrual cycle-based changes in productivity. However, literature from numerous studies provides some relevant insights that can build the understanding of this topic, providing a foundation for understanding the complex interplay between the menstrual cycle, hormonal fluctuations, and various aspects of women's health and wellbeing. Further research is needed to elucidate the specific mechanisms by which the menstrual cycle may impact productivity, taking into account contextual factors such as individual differences, work environments, and task demands. Several studies highlight the importance of the menstrual cycle

as a biomarker of women's general health and reproductive function (Vashishta & Gahlot, 2022; Karout et al., 2012).

The menstrual cycle is a complex cyclical physiological process consisting of fluctuations in estrogen, progesterone, follicle-stimulating (FSH) and LH (Song et al., 2022; Haryanti & Legiran, 2023). These hormonal changes have been shown to influence several cognitive and behavioural processes, ultimately influencing a person's productivity. Disruptions in the standard hormonal patterns of the menstrual cycle have been associated with various health outcomes. They could influence productivity by associating with a female's physical and mental well-being (Okoth et al., 2023). Additionally, research reveals that stress, physical activity, and body mass index can impact the menstrual cycle (Song et al., 2022; Ihsan et al., 2023). These factors may also independently influence productivity, either through physiological mechanisms or by affecting cognitive function, mood, and energy levels. This is particularly true for the late luteal phase, which tends to include premenstrual symptoms like mood shifts, irritability, and physical discomfort that can lead to interfered cognitive-emotional functioning (Leon et al., 2022; Klump et al., 2015).

One proposed mechanism involves the effect of estrogen on dopamine (DA) regulation in the brain. Several studies have revealed that estrogen modulates dopamine-dependent cognitive processes, including working memory and verbal learning (Jacobs & D'Esposito, 2011). In particular, estrogen can influence the activity of catechol-O-methyltransferase (COMT), an enzyme responsible for breaking down dopamine. Such adjustments can change cortical efficacy and task-related neural activity, which may affect a person's cognitive function and productivity (Jacobs & D'Esposito, 2011; Sacher et al., 2013).

In addition, the menstrual cycle has been linked to changes in functional brain connectivity in areas of the brain involved with spatial cognition and emotion processing (Weis et al., 2010). Changes in brain organization and activity across the menstrual cycle might lead to differences in cognitive functioning and mood that affect productivity (ibid). Furthermore, sensory processing and proprioception changes have also been associated with the menstrual cycle, which may have implications for physical performance and coordination. The precise effects of specific hormonal secretions remain elusive. However, it is well established that fluctuations of oestrogen and progesterone in premenopausal women can impact muscle, tendon/ligament function and the central nervous system and subsequently lead to a change in performance capabilities and tasks (Fouladi et al., 2011).

Available literature suggests that the menstrual cycle, as a reflection of women's overall health and hormonal status, could influence productivity through its effects on physical and mental well-being. However, the specific mechanisms underlying this relationship remain to be explored in future studies. Understanding these mechanisms can help inform strategies to support women's workplace productivity and well-being.

2.3 Menstrual Cycle Phase Monitoring in Construction Work

Hormonal and mood changes, as well as stress associated with the menstrual cycle, have been found to have significant impacts on an individual's physical and cognitive performance, which may be particularly relevant in the context of construction work. While the relationship between the menstrual cycle and productivity in construction work is not well-studied, research in other contexts, such as sports and the workplace, suggests that monitoring and managing the menstrual cycle may be beneficial (Mughal et al., 2021; Ahn et al., 2011). For instance, women's team sports coaches have been encouraged to routinely monitor their athletes' menstrual cycles and their impact on performance (Carmicheal et al., 2021; Mughal et al., 2021). These findings suggest that a workplace that takes these

factors into consideration can enhance women's' well-being, performance and overall productivity(Ahn et al., 2011).

The construction industry, with its physical demands and considerations of safety over time, could benefit from knowledge of the potential impact of the menstrual cycle on worker performance and interventions. Responses can include factoring menstrual cycles to work arrangements, and training on the physiological and psychological aspects in the workplace. (Ganesan et al., 2019).

3 Aim of the Study

This paper aims to explore the intersection of the relationship between the menstrual cycle and the construction of workplace productivity through a narrative review, focusing on an important yet underrepresented aspect of addressing diversity and productivity in the construction workforce. Although several scholars have examined gender diversity (Messing et al., 2009; Avilés-Palacios et al., 2013; Botha and Cronjé, 2015) and productivity in construction, Akinlolu et al.(2020) establish the absence of research on workplace health and safety challenges specific to women in male-dominated professions such as construction.

Existing literature suggests that hormonal fluctuations during the menstrual cycle can impact physical strength, endurance, cognitive performance, and mood, which may, in turn, influence work productivity and performance (Song et al., 2022; Haryanti & Legiran, 2023; Ihsan et al., 2023). However, the menstrual cycle's specific physical and psychological impact on productivity in the construction industry, which often involves physically demanding tasks, has yet to be well-studied. Studying these cyclical changes and their impact would create supportive work environments that foster higher performance and well-being of women in construction-related professions. This narrative review fills this gap by evaluating the impact of different menstrual cycle phases on task performance, safety, and overall productivity in female workplace populations. Additionally, this review will identify current gaps within this evidence base and inform directions for future research. The study's approach appropriateness lies in its flexibility, which responds to the complex and multidisciplinary nature of the research area. The approach supports synthesising findings from other fields with similar workplace nuances, such as physically demanding professions, which can inform responsiveness workplace interventions.

4 Research Methods

The current study used a narrative review approach to synthesise and analyse existing literature on menstrual cycle phases and workplace productivity. A narrative review approach was chosen as this method allows for more diversity of research and is interdisciplinary, capturing results from multiple areas of study on the same topic. The review process followed a systematic approach while maintaining the flexibility inherent to narrative reviews. The original literature search identified 127 potentially relevant peer-reviewed publications, including journal articles, conference proceedings and academic books published between 2008 and 2024. We focus on this period's literature because it encompasses seminal work and recent advances. The primary searches were done through academic databases: Google Scholar, Scopus, Science Direct, WoS, and PubMed. After adding inclusion criteria and quality assessment, 40 publications were selected for a final review. The search strategy used a combination of keywords such as: "menstrual cycle," "workplace productivity," "construction industry," "women in construction," "physical performance," "cognitive function," "hormonal effects," and "occupational health". Further articles were identified by citation tracking and reviewing the reference lists of relevant publications.

Studies examining the relationship between menstrual cycle phases and physical or cognitive performance, workplace productivity among construction and other physically demanding industries, studies related to women's health and safety in male-dominated professions, and studies which explored how hormones impacted work capabilities were included in the review. All final included publications were in English language and peer-reviewed journals. These publications contained 15 studies targeting the construction industry population, 12 studies targeting physical performance with hormonal impact, eight studies for cognitive function and its impact on workplace productivity and five on occupational health and safety in male-dominated fields.

Given the paucity of research on construction workers, the review deferred to research from related domains, including sports science, occupational health, and cognitive psychology, to make parallels and draw insights. The cross-disciplinary methodology facilitated the development of an enriched conceptual synthesis of potential impacts on the construction sector and highlighted knowledge stirring future research directions. The data synthesis focused on identifying patterns and relationships across studies; the differences in methodology and context of the reviewed studies were considered. Investigations focused on the relevance of the findings for the construction industry context, acknowledging the environmental and physical demands specific to construction work.

5 The Effect of the Menstrual Cycle Phase on Measured Work Productivity

5.1 Effects of MC Phase on Physical Strength and Endurance

Five studies examined the effects of the menstrual cycle on female physical strength and endurance. Clarke et al. (2021) examined the level of knowledge of male coaches regarding the menstrual cycle in women's team sports, including its impact on performance, health, and communication. The study suggested that coaches should encourage female athletes to track their menstrual cycle regularly and monitor its impact on their training and performance. Although this study is not specifically about construction or engineering work, it underscores the need to study how the menstrual cycle affects performance.

Köse (2018) examined the impact of menstrual cycle phases on aerobic-anaerobic capacity and muscle strength. The findings showed that the menstrual cycle phases had little to no effect on muscle strength and endurance, implying that it has a minimal effect on physical performance. Güler (2020) explored the menstruation period's effect on female volleyball players' sports performance. The results suggest that the period of menstruation had no significant impact on the power and performance of players, implying that menstrual phases do not have a universal impact on the physical performance of specific sports usage. A qualitative phase of a mixed-methods study by Kolić et al. (2021) explored women's physical activity experiences and the menstrual cycle. Participants reported physical symptoms and a lack of energy and motivation that made being physically active more difficult in certain menstrual phases and may have implications for performance. While performance may quantifiable in certain aspects, subjective experience can influence engagement in physical activity. Massulo et al. (2023) examined the impact of menstrual cycles on strength capacity in resistance exercises. Specifically, the authors noted a decrease in muscle performance only during the follicular phase, highlighting the need to consider menstrual cycle phases in making training plans for women. However, scientific evidence on the impact of the menstrual cycle on physical strength and endurance in construction or engineering work is lacking.

While some research has found differences in physical performance throughout the menstrual cycle, others have found no significant changes. Most of the available research targets the athletic population, and the results may be partially cogent to the construction and engineering work environment. Additionally, the physical nature of the work, workplace considerations, and individual differences in menstrual cycle experiences are likely qualitative factors in how the menstrual cycle interacts with physical performance in these professions. However, more studies are needed to specifically consider the influence of menstrual cycles on physical performance in construction and engineering. Such studies should consider task-specific physical demands, work environment and characteristics of individual menstrual cycles to understand this complex relationship fully.

5.2 Effects on MC Mental Acuity and Teamwork

Limited research has been conducted on the effect of the menstrual cycle on mental acuity and teamwork in construction or engineering work, and while early literature explored the suitability of women in male-dominated fields, more recent literature has delved into sex and gender differences in neurobiology rather than on how neurobiology affects teamwork in heavily male-dominated professions such as construction. These industries could benefit from a deeper understanding of how hormonal fluctuations affect cognitive performance, decision-making, and collaborative abilities. Wong-Goodrich et al. (2019) explored the variation of left hemisphere engagement during verbal processing across the menstrual cycle in women. They reported that the menstrual cycle phase had a moderate impact on investigated brain function and cognitive performance, indicating that the menstrual cycle may constitute a source of variability regarding cognitive performance. Using the Stroop task, Hatta & Nagaya (2009) found that women in the menstrual phase had superior performance on the memory task than women in the mid-luteal phase, concluding that cognitive performance may change across a woman's menstrual cycle. Poromaa and Gingnell (2014) reviewed how effectively the menstrual cycle may affect cognitive function and emotion processing, added that reliable studies on the menstrual cycle present various challenges, and noted that outcomes may depend on methodology and cognitive domains involved in the study. Arélin et al. (2015) employed restingstate fMRI to investigate the effects of the menstrual cycle on brain functional connectivity. The study measured progesterone and found it was associated with alterations in brain network organization, indicating hormonal fluctuations could impact cognitive and emotional processing. The evidence indicates that the menstrual cycle has a moderate potential effect on specific cognitive functions, including verbal processing, memory, and attention.

6 Limitations & Future Research

In interpreting the findings of this narrative review, a few important limitations should be considered. First, most of the existing research on menstrual cycle impact on physiological and cognitive performance originates from sports science and/or laboratory settings, wherein the conditions of demand and the environment experienced there are typically not reflective of those in construction. Secondly, most studies used a small sample of women and were specific to certain populations; therefor, the results should be generalised with caution. The review also revealed considerable gaps in the current literature. Longitudinal studies focusing on the long-term impacts of menstrual cyclerelated factors on workplace productivity in construction environments are particularly scarce. Furthermore, most studies have been poorly controlled for important factors, such as working conditions, task demands and the severity of the symptoms given how varied menstrual experience can be.

Further research is needed to specifically investigate the relationship between the menstrual cycle and productivity under actual construction site conditions. Such studies could explore the prevalence of menstrual cycle-related issues, the impact on task performance and safety, and the effectiveness of interventions aimed at supporting workers throughout their menstrual cycles. Studies may also investigate how changes in physical and cognitive capabilities during the menstrual cycle may affect construction tasks and roles differently. Finally, research is needed to develop practical guidelines for implementing menstrual cycle-aware policies in construction workplaces.

7 Conclusions

This narrative review synthesised current literature that examines the relationship between the phases of the menstrual cycle and productivity within the workplace with specific emphasis on its relevance to the construction industry. The studies demonstrate that menstrual cycle phases can influence physical and/or cognitive performance, but the effects are complex and highly individualised. Hormonal changes in the menstrual cycle can influence work performance in several ways, including changing levels of strength, endurance, and cognition, resulting in poorer emotional processing. The study results demonstrate the importance of addressing menstrual health in workplace design and policy across the construction sector. Although direct research on women working in construction has been limited or non-existent, findings from related areas suggest that recognising and accommodating the impacts of the menstrual cycle may be beneficial in enhancing workplace productivity and the health and safety of female construction workers. This review calls for the construction industry to challenge male-centric work culture and reform policies shaped by these biases to foster more equitable and inclusive workplaces.

This review examines how menstrual cycle-related physiological factors affect female workers' performance, moving beyond traditional productivity metrics. It demonstrates the need for construction industries to develop more supportive work environments that enable women's full professional participation. Such insights are essential to inform evidence-based interventions and policies that will improve productivity and worker well-being and further gender equity in the construction industry.

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