IMPACT OF MENSTRUAL CYCLE PHASES ON THE PHYICAL PERFORMANCE IN UNIVERSITY OF BENIN FEMALE-STUDENT ATHLETES.

BY

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CERTIFICATION

This dissertation by IMARHIAGBE-LEO GRACE IMOSE is accepted in its present form as satisfying for the degree of Bachelor of Physiotherapy of the School of Basic Medical Sciences, College of Medical Science of the University of Benin.

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DEDICATION

This dissertation is dedicated to God almighty, for giving me the strength and courage to finish this project. To my parents Mr and Mrs Imarhiagbe-Leo, and siblings Vivienne, Vera and Irene for their constant support.

ABSTRACT

Background
The menstrual cycle is a fundamental biological process that introduces considerable hormonal variability, affecting both physiological and psychological functioning in women. Although female participation in sports has grown, research focusing on women's athletic health remains scarce, especially within African settings where cultural norms and structural barriers often marginalize menstrual health considerations.

Aim
This research investigated the impact of menstrual cycle phases on physical performance, symptom profiles, and self-management strategies among female athletes at the University of Benin, Nigeria, to generate evidence informed recommendations for cycle aware training and athlete support.

Methods
Fifty three female athletes participated in this repeated measures study. Physical performance indicators strength, endurance, agility, and reaction time—were evaluated across the menstrual, follicular, ovulatory, and luteal phases. Data on body weight fluctuations and self-reported symptoms were analyzed using repeated measures ANOVA and Pearson's correlation tests, with significance set at 0.05.

Results
Significant phase dependent variations in physical performance were observed ($p < 0.05$). Strength, endurance, and agility were lowest during the menstrual phase, improved during the follicular and ovulatory phases, and declined slightly in the luteal phase. Reaction time was also slower during menstruation. Although body weight remained relatively stable, a significant phase related difference emerged, with slightly lower weight during the menstrual and follicular phases and higher values during ovulation and the luteal phase. A negative correlation was found between changes in body weight and endurance between the ovulatory and luteal phases ($r = -0.313$, $p = 0.023$). Frequently reported symptoms included cramps and fatigue during menstruation, bloating during ovulation, and irritability during the luteal phase. Approximately 40 percent of athletes did not track their cycles, and coaches were largely unaware of the performance variations linked to menstrual phases.

Conclusion
Menstrual cycle phases significantly influence physical performance among female athletes. The conventional "one size fits all" training model fails to accommodate their unique physiological changes. Individualized, cycle sensitive training programs that incorporate menstrual tracking and athlete coach communication are essential to enhance performance, reduce injury risk, and promote well being.

Keywords
menstrual cycle, female athletes, physical performance, hormonal fluctuation, University of Benin, Nigeria

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TABLE OF CONTENT

TITLE PAGE i

CERTIFICATION ii

DEDICATION iii

ABSTRACT iv

ACKNOWLEDGEMENT v

TABLE OF CONTENTS vii

LIST OF TABLES xi

CHAPTER ONE 1

INTRODUCTION 1

1.1 Background of the Study 1

1.2 Statement of problem 4

1.3 Aim of study 6

1.3.1 Specific objectives 6

1.4 Hypothesis 7

1.4.1 Main Hypothesis 7

1.4.2 Sub-Hypothesis 7

1.5 Scope of the study 8

1.6 Limitations of the study 9

1.7 Significance of the Study ..... **Error! Bookmark not defined.**

1.8 Definition of terms 11

1.9 List of abbreviations 12

CHAPTER TWO 13

LITERATURE REVIEW 13

2.1 Introduction 13

2.2 Menstrual cycle and Its Physiological Effects. .. **Error! Bookmark not defined.**

2.2.1 Overview of The Menstrual Cycle Phases ..... **Error! Bookmark not defined.**

2.2.2 Hormonal regulation of the menstrual cycle ... **Error! Bookmark not defined.**

2.2.3Phases of menstrual cycle: Physiological Transformations **Error! Bookmark not defined.**

2.3 Systematic Impact of Menstrual Cycle .... **Error! Bookmark not defined.**

2.3.1 Metabolism and Energy Homeostasis ..... **Error! Bookmark not defined.**

2.3.2 Sleep and Circadian Rhythm ..... **Error! Bookmark not defined.**

2.3.3 Body Temperature Regulation ..... **Error! Bookmark not defined.**

2.3.4 Mood and Cognitive function ..... **Error! Bookmark not defined.**

2.4 The Menstrual Cycle in Athletes: Performance, Health, and Management ..... **Error! Bookmark not defined.**

2.4.1 Training Adaptation and Performance ..... **Error! Bookmark not defined.**

2.4.2 Injury Risk and Recovery ..... **Error! Bookmark not defined.**

2.4.3 Menstrual Irregularities and RED-S ..... **Error! Bookmark not defined.**

2.4.4 Individual Variability and Influencing Factors. . **Error! Bookmark not defined.**

2.5.1 Variability in Cycle Lengths ..... **Error! Bookmark not defined.**

2.5.2 Nutrition and Menstrual Health ..... **Error! Bookmark not defined.**

2.5.3 Effects of Stress ..... **Error! Bookmark not defined.**

2.5.4 Physical Activity and Energy Availability .....**Error! Bookmark not defined.**

2.5.5 Hormonal Contraceptives in Athletes ..... **Error! Bookmark not defined.**

2.6 Conclusion ..... **Error! Bookmark not defined.**

2.7 EMPIRICAL REVIEW OF LITERATURE 42

CHAPTER THREE 42

MATERIALS AND METHODS 42

3.1 PARTICIPANTS ..... **Error! Bookmark not defined.**

3.1.1 INCLUSION CRITERIA .....**Error! Bookmark not defined.**

3.1.2 EXCLUSION CRITERIA ..... **Error! Bookmark not defined.**

3.2 MATERIALS 43

3.2.1 APPARTUS/INSTRUMENT 43

Validity and Reliability .....**Error! Bookmark not defined.**

3.3 METHODS 47

3.3.1 RESEARCH DESIGN ..... **Error! Bookmark not defined.**

3.3.2 SAMPLING TECHNIQUES/SAMPLE SIZE CALCULATION **Error! Bookmark not defined.**

Variables of the Study ..... **Error! Bookmark not defined.**

3.3.3 PROCEDURE OF DATA COLLECTION .... **Error! Bookmark not defined.**

3.3.4 ETHICAL CONSIDERATION ..... **Error! Bookmark not defined.**

3.3.5 DATA ANALYSIS .....**Error! Bookmark not defined.**

CHAPTER FOUR 52

RESULTS 52

4.1 Preamble ..... **Error! Bookmark not defined.**

4.1.1 Descriptive statistics of the respondents ..... **Error! Bookmark not defined.**

4.1.2 Physical performance and body weight across menstrual cycles .**Error! Bookmark not defined.**

4.1.3 Comparison of physical performance indicators across menstrual cycle phases ..... **Error! Bookmark not defined.**

4.1.4 Influence of menstrual cycle phases on body weight **Error! Bookmark not defined.**

4.1.5 Relationship between change in weight and change in physical performance across menstrual cycle phases 59

4.1.6 Menstrual-related symptoms reported by the respondents . **Error! Bookmark not defined.**

4.2: Hypothesis Testing 62

CHAPTER FIVE 64

DISCUSSION, CONCLUSION, RECOMMENDATION AND IMPLICATIONS 64

5.1 DISCUSSION ..... **Error! Bookmark not defined.**

5.2 CONCLUSION ..... **Error! Bookmark not defined.**

5.3 RECOMMENDATION ..... **Error! Bookmark not defined.**

5.4 IMPLICATION FOR FURTHER STUDY ..... **Error! Bookmark not defined.**

REFERENCE 69

APPENDIX 1 81

APPENDIX 2 82

LIST OF TABLES

Table 1: Physiological Changes and Hormonal Profiles across Menstrual Cycle Phases 20

Table 4.1: Descriptive statistics of the respondents 52

Table 4.2: Descriptive statistics of Physical performance and body weight across menstrual cycles 54

Table 4.3: Effect of menstrual cycle on physical performance (Repeated Measures ANOVA) 56

Table 4.3.1 Bonferroni Post Hoc Analysis 57

Table 4.4: Effect of menstrual cycle on weight (Repeated Measures ANOVA) 58

Table 4.4.1 Bonferroni Post Hoc Analysis 58

Table 4.5: Correlation between change in weight and change in physical performance 59

Table 4.6: Menstrual-related symptoms reported by the respondents 61

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The human body is remarkably intricate, with the female body representing a particularly delicate interplay of interconnected systems that influence one another in both subtle and significant ways. For female athletes, this complexity becomes especially important when considering the hormonal variations that occur across the menstrual cycle. In the field of sports, however, research and attention have traditionally been directed more toward male athletes, often treating female athletes as merely scaled-down versions of males. This assumption overlooks a fundamental biological process unique to females that plays a major role in their everyday functioning: the menstrual cycle.

Historically, sports science has been largely grounded in male-centered physiological models, frequently neglecting the distinct characteristics and requirements of female athletes (Oosthuysse & Bosch, 2010). Nevertheless, hormonal fluctuations during the menstrual cycle, particularly changes in estrogen and progesterone levels, can have considerable effects on physiological processes that are vital for athletic performance. These processes include energy metabolism, muscular strength, thermoregulation, and psychological state (McNulty et al., 2020). The relevance of this issue extends beyond theory, as it has practical implications for athletes, coaches, and sports professionals worldwide. Studies show that approximately 50% to 70% of female athletes perceive that their performance is influenced by different

phases of the menstrual cycle (Armour et al., 2020). Although objective performance outcomes may vary, many athletes report experiencing symptoms such as fatigue, bloating, discomfort, and mood fluctuations, which may negatively affect training, competition, and overall sporting experience (Martin, 2017; Meignié, 2021). Furthermore, communication about menstrual health between athletes and coaches is often limited, largely due to social stigma and insufficient awareness among coaching personnel (Armour et al., 2020; Solli et al., 2020). In addition, menstrual irregularities and related disorders are relatively common and are frequently linked to conditions such as Relative Energy Deficiency in Sport (RED-S), which can have long-term consequences for both health and athletic performance (Mountjoy et al., 2018). These factors underscore the importance of improving knowledge and management of menstrual health within the sporting context.

Across Africa, increasing female participation in sports mirrors global developments, although it is accompanied by unique challenges and opportunities. There has been a noticeable rise in the number of women and girls engaging in sports activities, supported by initiatives aimed at promoting gender equality and inspired by the achievements of African female athletes in disciplines such as athletics and football. Many nations are investing in development programs that encourage female involvement in both recreational and competitive sports (African Union, 2018). Despite these advancements, there remains a significant shortage of research addressing the specific physiological characteristics of African female athletes, particularly in relation to the menstrual cycle. Factors such as cultural expectations, limited research funding, and a historical focus on general public health issues have contributed

to the neglect of detailed sports science investigations in this area (Abiodun et al., 2019). This gap is important, as regional differences in environmental conditions, nutrition, and genetic background may influence how the menstrual cycle affects athletic performance.

In Nigeria, which is the most populous country in West Africa, interest and participation in women's sports continue to grow steadily. Nigerian female athletes have recorded significant achievements on the international stage in events such as athletics, football, and basketball, bringing recognition to the country (Adeleke & Okafor, 2022; International Olympic Committee, 2021). As the number of athletes increases, there is a corresponding need for more focused research on their physiological demands. Despite these accomplishments, empirical studies examining the influence of menstrual cycle phases on Nigerian female athletes remain limited and underdeveloped (Eze & Adebayo, 2020). Although preliminary findings suggest that menstrual-related symptoms may affect both performance and well-being (Mbah et al., 2021), there is insufficient structured data to inform training methods and support systems tailored to their specific needs.

The connection between menstrual health and athletic performance is a global issue that transcends geographical boundaries. With the increasing participation of women in sports and the continuous rise in performance expectations, it is essential to move away from generalized training approaches toward more individualized strategies that account for menstrual cycle variations (Mbah et al., 2021). This study, which focuses on female athletes at the University of Benin, seeks to provide context-specific data that will

contribute to the broader global effort aimed at enhancing support for female athletes through informed and personalized practices.

1.2 Statement of problem

Despite the increasing visibility and participation of female athletes on the global stage, a significant gap persists in the comprehensive understanding of how the natural hormonal changes associated with the menstrual cycle influence athletic performance. Although studies conducted internationally indicate that these hormonal variations can affect multiple dimensions of physical ability, and many female athletes themselves report fluctuations in performance across different phases of their cycle, such findings are rarely contextualized to suit specific regional settings, particularly in areas such as West Africa.

In the Nigerian context, particularly within academic and athletic institutions such as the University of Benin, there is a clear shortage of focused research on this issue. Female athletes in these environments must balance academic demands alongside their sporting commitments, yet prevailing training practices often fail to account for menstrual cycle–related variations. Consequently, both athletes and coaches may be deprived of essential scientific knowledge needed to modify training programs, anticipate performance shifts, or effectively manage discomfort and injury risks associated with different phases of the cycle. The absence of context-specific, evidence-based insights not only constrains performance optimization but may also contribute to heightened frustration

and ultimately restrict the attainment of peak performance and sustained well-being among female athletes in this setting.

1.3 Research questions

I. Are there significant differences in physical performance indicators (e.g., strength, endurance, speed, agility) across the different phases of the menstrual cycle (follicular, ovulatory, luteal) among female athletes in the University of Benin?

II. Which phase(s) of the menstrual cycle are most commonly associated with perceived decreases or improvements in physical performance among these athletes?

III. What menstrual-related symptoms (e.g., pain, fatigue, bloating, mood changes) are most frequently reported by female athletes, and how do these symptoms impact their training and competition?

IV. How aware are female athletes of their menstrual cycle phases, and to what extent do they track or monitor these phases in relation to their sports performance?

V. Do athletes who actively track their menstrual cycles report more effective symptom management or performance adaptations than those who do not?

VI. Is there a relationship between the severity of premenstrual symptoms and the level of performance variation observed across the cycle?

VII. How do body weight fluctuate across menstrual cycle phases, and do these variations correlate with any changes in physical performance?

VIII. To what extent are coaches and sports trainers aware of the impact of the menstrual cycle on female athletes' performance, and do they make any training adjustments based on this awareness?

IX. What barriers prevent female athletes from openly discussing menstrual cycle-related concerns with their coaches, teammates, or healthcare providers?

X. What practical strategies do female athletes use to cope with menstrual cycle-related challenges during training and competition, and how effective are these strategies perceived to be?

XI. Is there a noticeable difference in performance consistency between athletes with regular versus irregular menstrual cycles?

XII. What evidence-based recommendations can be derived from the findings to guide menstrual-cycle-informed training, recovery, and support for female athletes in Nigerian academic institutions?

1.3 Aim of study

The aim of the study was examine the influence of menstrual cycle phases on physical performance, symptom experiences, and self-management practices among female athletes in the University of Benin.

1.3.1 Specific objectives

I. To determine whether physical performance parameters (e.g., strength, endurance, speed, agility) significantly vary across the different phases of the menstrual cycle (follicular, ovulatory, and luteal) among female athletes.

II. To identify and analyse common menstrual-related symptoms (e.g., pain, fatigue, bloating, mood changes) experienced by female athletes and assess how these symptoms impact their athletic performance.

III. To evaluate the extent to which female athletes track their menstrual cycle and how this tracking influences their training, performance planning, and symptom management.

IV. To assess the level of awareness and understanding among female athletes about the relationship between the menstrual cycle and sports performance.

V. To explore the communication patterns between female athletes and their coaches or trainers regarding menstrual health and its influence on training and competition.

VI. To examine whether menstrual cycle regularity or irregularity is associated with consistency or variability in athletic performance.

VII. To develop practical, evidence-based recommendations for menstrual-cycle-informed training and athlete support strategies tailored to the needs of female student-athletes at the University of Benin.

1.4 Hypothesis

1.4.1 Main Hypothesis

I. There will be no significant difference in physical performance across the different phases of the menstrual cycle (follicular, ovulatory, and luteal) among female athletes attending the University of Benin.

1.4.2 Sub-Hypothesis

I. There will be no significant difference in specific types of physical performance (e.g., strength, speed, endurance, agility) across the follicular, ovulatory, and luteal phases among female athletes.

II. There will be no significant relationship between the severity of menstrual-related symptoms (e.g., pain, fatigue, bloating, mood changes) and the level of physical performance among female athletes.

III. There will be no significant difference in performance outcomes between athletes who track their menstrual cycles and those who do not.

IV. There will be no significant relationship between menstrual cycle regularity and consistency of physical performance in female athletes.

V. There will be no significant variation in hydration status and body weight across different menstrual cycle phases, and these variations will not significantly correlate with physical performance.

VI. There will be no significant difference in awareness or perception of menstrual cycle imp3act between athletes and their coaches.

1.5 Scope of the study

This study focused exclusively on female student-athletes enrolled in the University of Benin, who are actively engaged in organized sports. It aimed to examine how hormonal fluctuations across the menstrual cycle (follicular, ovulatory, and luteal phases) affect physical performance indicators such as strength, speed, endurance, and agility as well as symptom experiences and self-management practices. The research was geographically limited to the University of Benin, ensuring that findings are contextually relevant to Nigerian academic-athletic environments. Participants was be drawn from various sports (e.g., track and field, basketball, volleyball, swimming, or table tennis), with inclusion restricted to athletes within the School to ensure

academic and environmental consistency. Data collection occurred at one full menstrual cycle, allowing for valid comparisons across hormonal phases.

1.6 Limitations of the study

i. The duration for the study was short. It could only last for a least one cycle, so could not capture long-term trends or variability.

ii. The weather was not favourable as the study was done during the raining season. Due to the weather, training session would be cancelled or athletes would not show up for practice.

iii. This study focused mainly on the athletes and not the coaches who are a huge part of their sports career.

iv. This study could not get the target population due to athletes not meeting the inclusion criteria or not available or consenting to participate.

1.7 Significance of the Study

This research is important for several reasons, particularly because it addresses a relatively neglected aspect of sports science within Nigeria and the wider African context:

I. This study provides novel empirical evidence that helps bridge an existing knowledge gap by offering context-relevant insights into the effects of hormonal variations on the physical performance of female athletes in Nigeria.

II. Through an analysis of the relationship between menstrual cycle phases, performance, and overall well-being, the findings can assist coaches, sports scientists, and healthcare professionals in designing individualized, phase-responsive training and recovery strategies. Such applications may enhance performance outcomes, minimize injury risks, and support long-term athletic sustainability among female athletes.

III. The research underscores the relevance of monitoring menstrual cycles and increasing awareness of related symptoms in the context of sports performance. Improved awareness may enable female athletes to better regulate their training routines, address health concerns proactively, and help reduce the stigma often associated with menstrual health challenges that can affect performance.

IV. The outcomes of this study will offer meaningful insights for coaches, athletic trainers, and institutional authorities by improving their understanding of the physiological experiences of female athletes. This may promote more open dialogue, lessen cultural barriers, and support the incorporation of menstrual health considerations into sports policies within institutions such as the University of Benin and beyond.

V. By emphasizing gender-responsive perspectives, this study contributes to the advancement of more inclusive approaches in sports science research. It challenges the dominance of traditional male-centered performance models and advocates for the integration of female-specific biological factors, thereby promoting equity in performance evaluation.

VI. If effectively disseminated, the findings may guide national and regional sports organizations, including ministries and university athletic bodies, in the development of athlete support programs, menstrual health education initiatives, and long-term development strategies that are aligned with female physiological needs.

1.8 Definition of terms

I. Menstrual cycle: a regular biological cycle in mature females, lasting about 24 to 38 days, involving changes in the ovaries and the uterus to prepare for pregnancy. If no pregnancy occurs, the uterine lining is shed as menstruation

II. Estrogen: a female hormone made mainly by the ovaries. It supports growth of the uterine lining and contribute to higher energy and muscle building effects during the first half of the menstrual cycle (follicular phase)

III. Progesterone: a hormone produced by the corpus luteum after ovulation. It helps thicken and maintain the uterine lining for pregnancy. It is the dominant hormone during the luteal phase and is linked to some premenstrual symptoms.

IV. Menstruation: the visible phase of the menstrual cycle when the uterine lining is shed through the vagina usually lasting 3 to 7 day. It signals the start of a new cycle.

V. Follicular phase: the first part of the menstrual cycle, statin with menstruation and ending with ovulation.

VI. Ovulation: a mid-cycle event, usually around day 14 in a 28-day cycle, where a mature egg is released from the ovary due to surge in luteinizing hormone (LH), ready for fertilization.

VII. Luteal phase: the second half of the cycle, starting after the ovulation and ending with the next period.

VIII. Hormones: chemical substances made by glands like the ovaries and pituitary that regulates body functions

IX. Premenstrual Syndrome: a set of symptoms- physical, emotional, and behavioural- that occurs before menstruation and typically ease once it starts. These can include mood changes, tiredness, bloating, and

X. headaches, varying intensity.

1.9 List of abbreviations

GnRH- Gonadotropin-Releasing Hormone

HC- Hormonal contraceptive

HPO- Hypothalamic-Pituitary-Ovarian

LEA- Low energy availability

LH- luteinizing hormone

PMS- premenstrual syndrome

RED-S- Relative energy deficiency

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

As women increasingly overcome limitations and achieve success at every level of sport, from professional competition to recreational fitness, the need to understand female-specific physiology has become more critical. The worldwide rise in female athletic participation highlights the importance of tailoring training methods, nutritional strategies, and recovery practices to suit the unique biological rhythms that shape women's performance. (The Physiology of the Female Athlete – Performance, Health, and Recovery, 2022)

In contrast to the male reproductive system, the female reproductive system operates through recurring processes known as the menstrual cycle, which prepares the body for ovulation and potential conception. A primary outward manifestation of this cycle is menstruation, characterized by regular vaginal bleeding that occurs alongside hormonal fluctuations. The first occurrence of menstruation, known as menarche, typically begins during puberty, with an average onset age of approximately 12.4 years (Lacroix et al., 2023).

Fluctuations in key hormones, particularly estrogen and progesterone, extend their effects beyond reproductive functions. These hormonal changes can influence emotional states, including irritability and heightened sensitivity, as well as physical conditions such as energy levels, fatigue, skin changes like

acne, appetite variations, cravings, bloating, and breast tenderness (Ranney, 2025).

2.2 Menstrual Cycle and Its Physiological Effects

The menstrual cycle represents a continuous sequence of physiological changes within the female reproductive system. Its primary purpose is to prepare the body on a monthly basis for ovulation and the possibility of pregnancy. Rather than being a singular occurrence, it is a dynamic and coordinated process involving hormonal regulation and structural changes that facilitate reproductive readiness. Conventionally, the cycle is calculated from the first day of menstrual bleeding to the day preceding the onset of the next menstruation (Thiyagarajan et al., 2024).

Although a 28-day cycle is commonly referenced, actual cycle durations vary considerably, typically ranging from 21 to 38 days, with even longer cycles frequently observed among adolescents. This variation indicates that the 28-day model should be regarded as a general guideline rather than a strict standard (Department of Health & Human Services).

Beyond its reproductive role, the menstrual cycle exerts significant influence on various physiological systems. This broader impact underscores its importance as a central regulator of female biological function, coordinating numerous hormonal and bodily processes that contribute not only to fertility but also to overall health and stability. Irregularities in the cycle may signal underlying health issues, reinforcing its value as an indicator of general well-being. Consequently, there is a growing recognition that the menstrual cycle

should not be viewed solely in reproductive terms but also as a key factor in health, wellness, and physical performance (Women's Healthcare, 2024).

2.2.1 Overview of the Menstrual Cycle Phases

The menstrual cycle involves two interrelated processes: the ovarian cycle, which occurs within the ovaries, and the endometrial cycle, which refers to changes in the lining of the uterus (endometrium). These processes function in a coordinated manner, with hormonal signals from the ovaries directing the uterus to prepare for potential pregnancy in a synchronized and regulated way (Thiyagarajan et al., 2024).

The cycle is generally categorized into four distinct phases:

- **Menstrual Phase (Menstruation):** This phase begins on the first day of the cycle and involves the shedding of the uterine lining, composed of blood, mucus, and tissue. Lasting approximately 3 to 7 days, it signifies both the conclusion of the previous cycle and the initiation of a new reproductive cycle (Admin, 2025).
- **Follicular Phase:** Occurring concurrently with menstruation and continuing until ovulation, this phase is characterized by the growth and maturation of ovarian follicles, each containing an immature egg. At the same time, increasing hormone levels stimulate the rebuilding and thickening of the uterine lining in preparation for possible implantation (Admin, 2025).
- **Ovulation:** Typically taking place around the midpoint of the cycle, approximately 14 days before the next menstrual period, ovulation involves the release of a mature egg from the dominant follicle into the

fallopian tube. This phase represents the period of highest fertility (Department of Health & Human Services., n.d.).

- **Luteal Phase:** Following ovulation, the remaining follicular structure transforms into the corpus luteum, which secretes hormones necessary to maintain the thickened uterine lining. In the absence of fertilization, the corpus luteum degenerates, leading to a decline in hormone levels and the onset of menstruation, thereby initiating a new cycle (McLaughlin, 2025).

The precise coordination between the ovarian and endometrial cycles demonstrates a high level of biological integration. Hormonal signals originating from the ovaries regulate uterine changes with remarkable accuracy, ensuring that both processes remain synchronized. Disruption in one aspect of the cycle can affect the other, highlighting the strong interdependence between these systems (The Ovarian Cycle, the Menstrual Cycle, and Menopause Thiyagarajan et al., 2024).

2.2.2 Hormonal Regulation of the Menstrual Cycle

1. The Hypothalamic–Pituitary–Ovarian (HPO) Axis

The menstrual cycle does not occur by chance but instead proceeds through a highly organized physiological process. Central to this process is the Hypothalamic–Pituitary–Ovarian (HPO) axis, an integrated communication system involving three key endocrine structures: the hypothalamus, located in the brain; the pituitary gland, situated at its base; and the ovaries. These components operate through a complex hormonal feedback mechanism in

which the activity of each gland influences the others, thereby ensuring proper regulation of the cycle.

This system functions in a manner similar to a regulatory control mechanism, continuously adjusting hormone levels to sustain equilibrium. Such balance is crucial for fundamental reproductive events, including follicular development, ovulation, and the preparation of the uterine lining for possible implantation. Due to the close interdependence of the HPO axis, it is particularly sensitive to both internal physiological conditions and external influences. Consequently, factors such as chronic stress, nutritional status, and excessive physical activity may disrupt hormonal balance, leading to irregularities in the menstrual cycle. This underscores the strong connection between menstrual function and overall health, as well as its susceptibility to lifestyle and environmental conditions.

2. Key Hormones: Roles and Interactions

The regulation of the menstrual cycle by the HPO axis is achieved through the coordinated release and interaction of several essential hormones:

- **Gonadotropin-Releasing Hormone (GnRH):** Secreted in a pulsatile manner by the hypothalamus, GnRH stimulates the anterior pituitary gland to release follicle-stimulating hormone (FSH) and luteinizing hormone (LH). The frequency of GnRH pulses is critical in determining hormonal output, with slower pulses favouring FSH secretion and more rapid pulses enhancing LH release.
- **Follicle-Stimulating Hormone (FSH):** Produced by the pituitary gland, FSH plays a vital role in the early phase of the cycle by promoting the

maturation of ovarian follicles. It also facilitates the production of estrogen and inhibin B by granulosa cells and induces the development of LH receptors in the dominant follicle, thereby preparing it for ovulation. Regulation of FSH occurs within a defined "FSH window," during which initial elevation supports follicular growth. As levels of estrogen and inhibin B rise, they exert negative feedback on FSH secretion, allowing only the most advanced follicle to continue developing while the others regress.

- **Luteinizing Hormone (LH):** Also secreted by the pituitary, LH works synergistically with FSH to regulate ovarian function. It promotes the synthesis of steroid hormones and is responsible for triggering ovulation through a rapid and pronounced increase in its concentration, commonly referred to as the LH surge.
- **Estrogen (17-β Estradiol):** Synthesized by developing ovarian follicles, estrogen plays a key role in thickening the endometrial lining in preparation for possible pregnancy. It exhibits both negative and positive feedback effects: at lower concentrations, it suppresses FSH and LH secretion, whereas sustained high levels reverse this effect, stimulating the LH surge that initiates ovulation.
- **Progesterone:** Following ovulation, the ruptured follicle transforms into the corpus luteum, which secretes progesterone. This hormone stabilizes the endometrium to support potential implantation, increases the viscosity of cervical mucus to restrict sperm entry, and causes a slight elevation in basal body temperature. In conjunction with estrogen, progesterone also suppresses the secretion of GnRH, FSH, and LH,

thereby preventing the development of additional follicles during early pregnancy.

- **Testosterone:** Although primarily associated with male physiology, testosterone is also produced in small amounts by the ovaries in females. It contributes to sexual drive, supports muscle maintenance, and plays a role in the regulation of the menstrual cycle.
- **Inhibin B and Activin:** These regulatory peptides, secreted by granulosa cells, are involved in the fine-tuning of FSH levels. Inhibin B acts to suppress FSH secretion, whereas activin enhances it; together, they help maintain hormonal balance by modulating GnRH signalling pathways.

2.2.3 Phases of the Menstrual Cycle: Physiological Transformations

The menstrual cycle consists of distinct phases, each characterized by specific physiological changes and unique hormonal patterns. These sequential hormonal fluctuations operate in a coordinated manner to prepare the female body for the possibility of conception. As a result, the menstrual cycle can be understood as a dynamic and continuously regulated biological process, reflecting ongoing interactions between endocrine signals and reproductive structures.

Table 1: Physiological Changes and Hormonal Profiles across Menstrual Cycle Phases

Phase	Approximate	Key Hormonal	Physiological Changes
Menstrual Phase	Days 1-7 (overlaps with early follicular)	Estrogen & Progesterone: Low and declining	Uterine lining (endometrium) sheds, resulting in menstrual bleeding (blood, mucus, tissue). Common symptoms:
Follicular Phase	Days 1-14 (starts with menstruation, ends with ovulation)	FSH: Rises, then declines. Estrogen (Estradiol): Gradually rises, peaking just	Ovarian follicles mature, with one dominant follicle developing. Uterine lining thickens (proliferative phase) due to estrogen
Ovulation Phase	Day 14 (approx. 24 hours)	LH: Sharp surge (peak). Estrogen: Peaks just before LH surge, then	Mature egg released from dominant follicle. Egg travels down fallopian tube. Slight

Luteal Phase	Days 15-28 (approx. 11-17 days)	Progesterone: Rises significantly, peaks mid-phase, then declines if no pregnancy. Estrogen: Rises after ovulation, then declines if no pregnancy. FSH	Corpus luteum forms from ruptured follicle. Uterine lining continues to thicken and becomes secretory, preparing for implantation. Cervical mucus becomes thick, dry, and paste-like. Basal body temperature remains elevated (0.4°F/0.22°C increase). Common symptoms: bloating, breast tenderness,

Each stage of the menstrual cycle does not function as an isolated event but rather forms part of a seamlessly integrated and ongoing process. Hormonal fluctuations across these phases elicit distinct responses from both the uterus and ovaries, underscoring the remarkable capacity of the uterus to adapt. A pertinent illustration is the dual regulatory function of estrogen, which first suppresses and subsequently stimulates hormone secretion, thereby orchestrating the precise transition from follicular development to ovulation. Following ovulation, progesterone assumes a dominant role, meticulously preparing the endometrial lining to support a potential pregnancy. This intricate interplay reflects the exceptional physiological harmony that underpins the reproductive system (Watson, 2023).

2.3 Systematic Impact of Menstrual Cycle

The rhythmic fluctuations in hormones that characterize the menstrual cycle exert influences that extend well beyond reproductive function. They affect a range of physiological and emotional processes throughout the body, reinforcing the concept that the menstrual cycle serves as both a significant indicator and a regulator of comprehensive health and well-being in women (Wikipedia contributors, 2025).

2.3.1 Metabolism and Energy Homeostasis

The menstrual cycle exerts a considerable influence on fundamental physiological functions, particularly metabolism and energy regulation. Evidence consistently indicates that energy expenditure is elevated during the

luteal phase relative to the follicular phase. During this period, average core body temperature rises by approximately 0.27°C, accompanied by an increase in energy expenditure of roughly 6.9% (Baker et al., n.d.). This phenomenon is likely attributable to the thermogenic properties of progesterone, which become pronounced in the luteal phase. Consequently, metabolic rate accelerates, frequently resulting in heightened appetite and shifts in substrate utilization that favor lipid oxidation over carbohydrate metabolism (Bisdee et al., 1989). These physiological adjustments point to increased energy demands and altered homeostatic balance, with practical implications for tailoring nutritional intake and physical activity during this stage of the cycle (Greenfield et al., 2021).

2.3.2 Sleep and Circadian Rhythm

Hormonal variations throughout the menstrual cycle can substantially influence sleep architecture and circadian rhythms. Estrogen and progesterone fluctuations play a critical role in determining sleep duration and quality. During the luteal phase, progesterone elevates core body temperature, potentially complicating sleep onset and maintenance. Additionally, it modulates neurotransmitters such as serotonin and GABA, both of which are integral to the regulation of restorative sleep (Cherpak & Van Lare, 2019).

Sleep disturbances exhibit considerable interindividual variability and may be exacerbated by physical symptoms such as cramping, headaches, or general discomfort, particularly during menstruation and the late luteal phase. Many individuals experience shortened sleep duration and increased fragmentation

during this timeframe, with lighter sleep often supplanting deeper stages. Inadequate sleep can, in turn, disrupt hormonal equilibrium and contribute to menstrual disorders such as dysmenorrhea and menorrhagia, conditions frequently associated with elevated prostaglandin levels.

2.3.3 Body Temperature Regulation

Body temperature follows a predictable trajectory across the menstrual cycle, predominantly governed by progesterone. Among ovulating individuals, a consistent elevation in basal body temperature (BBT) is observed during the luteal phase, particularly noticeable during nighttime hours, when compared with the follicular phase (Baker et al., 2020). This increase, typically around 0.22°C (0.4°F), serves as a dependable marker of ovulation and signifies the onset of the luteal phase. This temperature rise results from increased heat production coupled with diminished heat dissipation, especially during the initial stages of sleep. Progesterone exerts a hyperthermic effect by raising the body's core temperature set point prior to activating heat-loss mechanisms such as cutaneous vasodilation.

2.3.4 Mood and Cognitive Function

The menstrual cycle can exert noticeable effects on emotional state and cognitive performance, although consistent patterns in objective cognitive measures remain less well defined than subjective reports might suggest. Emotional difficulties, including pronounced premenstrual symptoms and premenstrual dysphoric disorder (PMDD), are relatively prevalent, typically

emerging approximately one week prior to menstruation and subsiding shortly after its onset. These manifestations are closely linked to progesterone exposure during the luteal phase (Jang et al., 2025). Research further indicates that during this phase, individuals may experience greater difficulty in accurately interpreting negative emotional stimuli, with neuroimaging studies consistently demonstrating heightened amygdala reactivity to such stimuli—again, likely mediated by progesterone's influence (Andreano & Cahill, 2010). Although sex-differentiated variations in certain cognitive domains tend to be subtle and inconsistently replicated, some evidence suggests that verbal working memory may be enhanced during periods of elevated estradiol, such as the late follicular or mid-luteal phases. Ongoing investigation continues to explore the complex interplay between fluctuating hormone levels, neural function, and emotional processing, an area that remains both dynamic and incompletely understood (Wikipedia contributors, 2025).

2.4 The Menstrual Cycle in Athletes: Performance, Health, and Management

A thorough understanding of the menstrual cycle is critical for female athletes, as it significantly influences training responses, competitive performance, injury susceptibility, and overall health. Recognizing these hormonal and physiological dynamics is essential for optimizing performance and ensuring sustainable athletic development and well-being (Carmichael et al., 2021).

2.4.1 Training Adaptation and Performance

Fluctuating hormonal concentrations across the menstrual cycle can affect both physical performance and an athlete's capacity to tolerate training loads. Although subjective reports from many female athletes frequently indicate performance variations—particularly during the early follicular and late luteal phases—objective measures do not always align with these perceptions. This discrepancy highlights the interaction between physiological and psychological factors (Greenbox, 2023). Nevertheless, the cyclical nature of hormonal change underscores the importance of individualized training and nutritional strategies rather than the application of a generalized approach:

- **Follicular Phase (Low Hormone Levels):** This phase is typically optimal for high-intensity exercise and strength development. Reduced hormone levels facilitate greater accessibility to carbohydrate stores, thereby supporting more demanding training sessions. In the latter part of this phase, estrogen's stimulatory effects on the nervous system may further augment strength and power output. Recovery tends to be expedited, and exercise sessions are often perceived as less strenuous.
- **Luteal Phase (High Hormone Levels):** Elevated concentrations of estrogen and progesterone during this phase may impair muscle protein synthesis and reduce carbohydrate availability, prompting a metabolic shift toward fat utilization. Consequently, training may feel more taxing, with fatigue occurring more rapidly. Therefore, this phase is often better suited to lighter resistance work, endurance-based activities, or

active recovery. Furthermore, progesterone's depressant effect on neural activity may contribute to diminished strength and heightened neuromuscular fatigue (Hayward, 2024).

2.4.2 Injury Risk and Recovery

Hormonal variations throughout the menstrual cycle can affect both an athlete's susceptibility to injury and their capacity for recovery (Hayward, 2024). Evidence suggests that around the time of ovulation, hormonal shifts—particularly involving estrogen—may increase ligamentous laxity, potentially elevating injury risk (Jones et al., 2024). Estrogen may also suppress collagen synthesis, which can compromise the structural integrity of muscles and tendons, thereby influencing performance during explosive, reactive movements and increasing the likelihood of soft-tissue injury (Chidi-Ogbolu & Baar, 2019). Effective recovery management is a cornerstone of injury prevention and sustained athletic health. Utilizing monitoring tools such as heart rate variability and muscle recovery metrics can assist in determining an athlete's readiness for high-intensity training versus the need for additional rest. Such data facilitate flexible, individualized training adjustments that promote both performance and long-term health (Mcmillan, n.d.).

2.4.3 Menstrual Irregularities and RED-S

Menstrual disturbances, including oligomenorrhea (infrequent menstruation) and amenorrhea (absence of menstruation), are frequently observed in female athletic populations. These conditions are often associated with Relative

Energy Deficiency in Sport (RED-S), a syndrome resulting from low energy availability (LEA) (Coelho et al., 2021). LEA arises when an individual's caloric intake fails to meet the energy demands of both exercise and essential physiological functions.

RED-S can precipitate hormonal imbalances and metabolic suppression, adversely affecting not only reproductive health but also bone density, immune function, cardiovascular health, and psychological well-being. Early detection is facilitated by instruments such as the IOC RED-S Clinical Assessment Tool and screening questionnaires including the LEAF-Q and BEDA-Q. Prompt identification and management of these issues are vital to safeguarding long-term health and sustaining athletic performance.

2.4.2 Individual Variability and Contributing Factors

Although the menstrual cycle constitutes a fundamental physiological process, its characteristics differ considerably across individuals, rendering the notion of a standard "28-day cycle" a general benchmark rather than a universally applicable norm. These variations arise from a combination of internal physiological mechanisms and external lifestyle factors (Helm et al., 2021).

2.5.1 Variation in Cycle Duration

Cycle lengths typically fall within a range of 22 to 36 days, with over 40% of individuals experiencing fluctuations exceeding seven days between consecutive cycles. Such inconsistency is predominantly attributed to the

follicular phase, which exhibits greater variability in duration (ranging from 10 to 22 days), whereas the luteal phase remains comparatively consistent at approximately 14 days. This underscores the importance of individualized cycle tracking over standardized expectations (Fehring et al., 2006).

2.5.2 Dietary Influences on Menstrual Health

Nutrition significantly affects hormonal regulation and the mitigation of menstrual symptoms.

- **Overall Dietary Patterns:** A well-balanced diet comprising fruits, vegetables, complex carbohydrates, and proteins supports consistent menstrual cyclicity. Additionally, foods rich in omega-3 fatty acids may contribute to reduced inflammation.
- **Phase-Specific Nutrition:**
    - **Follicular Phase:** Emphasis should be placed on antioxidant-dense fruits and cruciferous vegetables to bolster immune function and estrogen metabolism.
    - **Ovulatory Phase:** Hydrating foods along with sources of B vitamins aid in managing fluid retention and sustaining energy levels.
    - **Luteal Phase:** Given metabolic alterations during this stage, prioritizing complex carbohydrates and magnesium-rich foods can alleviate cravings and premenstrual symptoms.

- **Menstrual Phase:** Consuming iron-rich foods in conjunction with vitamin C facilitates the replenishment of lost iron and supports energy maintenance (Gornall, 2024).

- **Nutritional Deficiencies and Precautions:** Inadequate zinc levels may disrupt menstrual regularity, whereas excessive consumption of soy (containing phytoestrogens) could potentially inhibit ovulation. Reducing intake of sugar, caffeine, and alcohol may alleviate severe symptoms, particularly in cases of premenstrual dysphoric disorder (Brown et al., 2023).

2.5.3 Impact of Stress

Stress disrupts endocrine equilibrium through hyperactivation of the hypothalamic–pituitary–adrenal (HPA) axis, which in turn interferes with the hypothalamic–pituitary–ovarian (HPO) axis responsible for regulating the menstrual cycle (Sic et al., 2025). Elevated cortisol levels can suppress reproductive hormones, resulting in irregular or absent menstruation. As progesterone participates in both stress responses and reproductive processes, stress may also alter the duration of the luteal phase, causing it to shorten or lengthen. Implementing relaxation strategies to mitigate stress is therefore essential for maintaining cycle regularity (Dickson, 2022).

2.5.4 Physical Activity and Energy Availability

Physical activity exerts a notable influence on menstrual function, particularly when combined with insufficient nutritional intake (Grabia et al., 2024).

- **Phase-Based Exercise Considerations:**
    - **Follicular Phase:** This period is optimal for high-intensity and strength-focused training, as recovery capacity is enhanced and carbohydrate availability is elevated.
    - **Luteal Phase:** Lower-intensity exercise and recovery-focused activities are more suitable during this phase. Elevated hormone levels can increase perceived exertion, while hydration requirements rise.
- **Considerations for Athletic Performance:** Synchronizing training regimens and nutritional strategies with the phases of the menstrual cycle may enhance athletic performance and reduce the risk of injury or overtraining (Carmichael et al., 2021).

2.5.5 Hormonal Contraceptives in Athletes

Among female athletes, hormonal contraceptives (HCs) are frequently employed to regulate menstrual cycles or to manage timing around competitive events. Although HCs can alleviate symptoms and provide greater predictability, their influence on athletic performance remains inconsistent. Some athletes experience positive effects, whereas others discontinue use due to adverse reactions such as mood fluctuations and

weight gain. Further investigation is required to fully clarify their impact on performance outcomes (Nolan et al., 2023).

2.6 Conclusion

The menstrual cycle constitutes a complex and adaptive biological rhythm that holds significant importance for women's health. Extending beyond its reproductive role, it affects multiple physiological systems and serves as a vital indicator of overall well-being. Hormonal regulation via the Hypothalamic-Pituitary-Ovarian (HPO) axis drives critical changes in the ovaries and uterus to facilitate potential pregnancy. However, this hormonal equilibrium remains susceptible to lifestyle and environmental factors, including nutrition, psychological stress, and physical activity, all of which may influence cycle regularity and presentation.

Broad Physiological Influence: The menstrual cycle governs not only fertility but also metabolic function, energy expenditure, thermoregulation, sleep architecture, emotional state, and cognitive performance (Morrison et al., 2022; Torgrimson & Minson, 2005). Menstrual irregularities frequently signal underlying disruptions to general health (De Souza et al., 2020).

Inherent Variability: While a 28-day cycle is commonly referenced as a standard, it should be viewed as a general benchmark rather than a fixed norm. Notable variability exists both across different individuals and within the same individual over time, largely attributable to differences in the

length of the follicular phase (Bull et al., 2019; Fehring et al., 2006). This underscores the necessity of individualized approaches to menstrual health management.

External Determinants: Environmental influences, particularly persistent stress or inadequate caloric intake relative to energy expenditure, can interfere with signaling along the HPO axis. Such disruptions reflect the body's prioritization of survival mechanisms over reproductive processes, highlighting the importance of comprehensive wellness strategies (Mountjoy et al., 2018; Nattiv et al., 2007).

Implications for Athletes: A substantial number of female athletes report perceived variations in performance across different phases of the menstrual cycle, despite inconsistent empirical evidence. Nonetheless, documented fluctuations in parameters such as metabolism and core temperature provide a compelling basis for tailoring training regimens and nutritional intake to align with hormonal shifts (McNulty et al., 2020; Carmichael et al., 2021). Although hormonal contraceptives are widely used to control the menstrual cycle, their precise effects on athletic performance remain uncertain and warrant further study (Elliott-Sale et al., 2020).

2.7 EMPIRICAL REVIEW OF LITERATURE

AUTHOR/YEAR/ COUNTRY	TITLE	SAMPLE SIZE	AIM OF STUDY	STUDY TYPE	OUTCOME MEASURE	FINDINGS
Alice Meignie et al., /2021 France.	The effects of menstrual cycle phase on elite athlete performance: a critical and systematic review.	314 elite female participants	Systematicall y review publication that have been investigated the link between the MC phases and the performance in elite female athletes.	systemati c review	Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)	Different sports performance related parameters are affected during the menstrual cycle among elites athletes, but the parameters themselves and the magnitude and the direction of the effects are inconclusive.
Aysenur Turan et al., 2024 Turkey	Prevalence and correlates of premenstrual syndrome and premenstrual dysphoric disorder among	1125 female college students	To determine the prevalence and correlates pf PMS and PMDD in women aged	A cross-sectional study	A personal information form, the international Physical Activity questionnaire	PMS was found in 49.2% and 48% of the participants. In addition, women with PMS were less likely to be physically active based on the metabolic

	women aged 18-25 in Turkey.		18-25 in Turkey.		and the Premenstrual Syndrome Scale(PMSS).	equivalent task score.
Bernadette C Taim et at., /2023	The prevalence of menstrual cycle disorders and menstrual cycle-related symptoms in female athletes: a systematic literature review	60 studies involving 6380 athletes were included.	To examine the prevalence of MC disorders and MC-related symptoms can have debilitating effects on the health and performance of female athletes.	Systematic review	Modified Downs and Black checklist.	A side range of prevalence was observed for all types of MC disorders, with a dearth of data on anovulation and LPD.
Candice MacMillan et al., /2024	The association between menstrual cycle phase, menstrual irregularities, contraceptive use and musculoskeletal injury among	96 articles.	Aims to summarise the coverage of the literature related to the extent, nature and characteristic	Systematic review and meta-analyses	Preferred reporting items for systematic review and meta-analysis extension for scoping reviews (PRISMA-ScR). And JBI	Research related to MCP, MI and HC as contributing MSK injury risk factors is increasing. However, several gaps have been identified, among non-professional/elite-level athletes, in team sports

	female athletes: a scoping review.		s of the influence of MCP, MI and MC use on musculoskeletal injuries among the athletes.		guidelines	and specific injuries related to MCP, MI and HC, respectively.
Dan Gordon et al., /2013 United kingdom.	The effects of menstrual cycle phase on the development of peak torque under isokinetic conditions	17 well trained females	Examining the effects of menstrual cycle phase on the development of peak torque across a range of isokinetic speeds.	Reported - measures experimental design.	Peak torque.	There are significant fluctuations in peak torque of the knee extensors in response to phases of the menstrual cycle associated with variances in the female sex hormones. The finding have implications for the planning of strength training in female athletes.
Daniel Martin et al., /2018	Period prevalence and perceived side effects of hormonal contraceptives	430 elite female athletes	To identify the period prevalence of hormonal contraceptive use and the	A cross-sectional study	Questionnaire	Approximately half of the elite athletes used HC's and progestin-only contraceptives users reported greater incidence of negative side effects,

	use and the menstrual cycle in elite athletes.		characterize the perceived side effects associated with the menstrual cycle and hormonal contraceptive use.			especially with the implant.
Ellen Casey et al., /2016	Influence of menstrual cycle and oral contraceptive phase in spinal excitability	30 healthy women (18-35).	To determine whether changes in sex hormone concentration would alter spinal excitability, measured across the menstrual and oral contraceptive pill cycle.	Prospecti ve cohort study	H-reflex(Hmax/M max ratio), serum estradiol and concentrations were measured at 3 times points during the menstrual and contraceptive pill cycle.	Acute fluctuations of endogenoud estradiol and progesterone do not modulate spinal excitability. However, long-term exposure to exogenous estrogene and progesterone(oral contraceptives) might have an impact on spinal excitability and neuromuscular control.
Emilija stojanovic et al., /2016	Effect of polymetric training on	16 studies met the inclusion	To determine the effectiveness	Systemat ic review and	6 electronic data base (PubMed, MEDLINE,	Plyometric training is an effective form of training to improve VJ

	vertical jump performance in female athletes: a systematic review and meta-analysis	criteria.	of polymetric training on vertical jump performance of amateur, collegiate and elite female athletes.	meta-analysis	ERIC, Google Scholar, SCIndex and ScienceDirect). Physiotherapy evidence base (PEDro)	performance in female athletes.
Guro S. Solli et al., /2020	Changes in self-reported physical fitness, performance, and side effects across the phase of the menstrual cycle among competitive endurance athletes.	140 participants competing in biathlon or cross-country skiing at the (inter) national level were analysed.	To investigate changes in self-reported physical fitness, performance, and side effects across the menstrual cycle	Cross-sectional study	Online questionnaire	A high proportion of athletes perceived distinct changes in fitness, performance, and side effects across the MC **phase**, with their worst perceived fitness and performance during the bleeding phase.
Hannah E Cabre et al., /2024	Effects of hormonal contraception and the menstrual cycle on fatigability and recovery from an	Subjects were randomly assigned.	To evaluate the effects of oral contraceptive an hormonal intrauterine device (H-IUD) use,	Repeated measure study	Repeated sprint cycle test	In recreationally active women, hormonal contraception and hormone phases may minimally impact fatigue and recovery.

	anaerobic exercise test		compared with a eumenorrheic (EUM) cycle, on fatigability and recovery between hormone phases.			
Heng Wu et al., /2024	Prevalence and correlation of menstrual dysphoric disorder: a sample of adult working women	1710 participants	Aims to investigate the prevalence of PMDD among adult working women and identify associated etiological factors.	A cross-sectional study	Questionnaire based survey	PMDD is a notable concern among adult working women. Key factors such as age, age at menarche, income level, menstrual cycle characteristics, menstrual symptom presence, physical activity and caffeine intake, significantly contribute to the likelihood of developing PMDD.
Jaewon Yang et al., 2014 Korea.	Survey of premenstrual symptom severity and	948 girls	Aims to examine the prevalence of premenstrual	A cross-sectional study	An adolescent mental questionnaire, centre of	The symptoms intensity and frequency of the subthreshold PMDD subjects were similar to

	impairment in Korean adolescents: premenstrual dysphoric disorder, subthreshold premenstrual dysphoric disorder and premenstrual syndrome.		dysphoric disorder (PMDD), subthreshold PMDD and premenstrual syndrome among adolescents and too assess the nature of symptom and the impact on daily life function, especially for PMDD and subthreshold PMDD.		epidemiological studies-depression scale, revised children's manifest anxiety scale and menstrual information questionnaire.	those in subjects with PMDD. Psychiatric problems, including depression and anxiety were higher in the PMDD and subthreshold PMDD groups than in the moderate/severe PMS and no/mild PMS group.
Johanna K Ihalajnen et al., /2024	Self-reported performance and hormonal-cycle-related symptoms in competitive female athletes.	959 female athletes	To determine if menstrual cycle and hormonal contraceptive cycle only influence	Cross sectional study	questionnaire	Perceived negative effects on performance were similar in both NM and HC groups while perceived mental performance (e.g., mood and attention) appeared to

			performance			be most affected by both MC and HC.
Kurt Vogel et al., /2023	Female athletes and the menstrual cycle in team sports: current state of play and consideration for future research.	Articles from year of publication (between 1990 and 2023).	This article will explore the current state of women's sport science research and provide recommendation guidelines for female athletes physical performance testing protocol to be used in future research	Systematic review	Database searched included PubMed, SCOPUS and Google scholar	Recommendations: it is imperative that future research also enhances their evidence base by (a) capturing data on health and wellbeing factors such as sleep, nutrition an training intensity, and volume information (b) including youth female athletes; (c) including females with menstrual cycle irregularities (d) including females who are on hormonal contraceptives.
Mariola Czajkowaska et al., /2015	Menstrual cycle and the prevalence of premenstrual syndrome/Premenstrual	75 female athletes	To assess the menstrual cycle, menstrual disorders and premenstrual	Prospective study	Purpose-built questionnaire, a daily log of PMS symptoms according to the American	The prevalence of PMS increases with the duration and intensification of competitive exercise.

	dysphoric disorder in adolescent athletes.		syndrome/premenstrual dysphoric disorder in girls and young women participating in competitive sports.		college of obstetricians and gynaecologists' guidelines and a daily log of PMDD symptoms based on the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders, Fourth edition, diagnostic criteria	

CHAPTER THREE

MATERIALS AND METHODS

3.1 PARTICIPANTS

The study population comprised female student-athletes at the University of Benin who meet the following criteria: engagement in systematic athletic training, possession of a natural and regular menstrual cycle suitable for tracking, and willingness to undergo monitoring throughout the duration of one complete menstrual cycle.

3.1.1 INCLUSION CRITERIA

I. Female student-athletes of reproductive age, falling within the range of 16 to 35 years.

II. Participants must be competitive athletes currently engaged in structured training regimens or competitive sports programs at the University of Benin.

III. The study includes athletes participating in football, basketball, volleyball, handball, and swimming.

III. Participants are required to demonstrate a consistent menstrual cycle, lasting between 21 and 35 days, over the preceding three months.

V. Participants must be in satisfactory health, presenting no diagnosed chronic or acute medical conditions that could interfere with athletic performance or menstrual function.

IV. Each participant must provide voluntary informed consent and commit to being monitored for no fewer than one full menstrual cycle.

3.1.2 EXCLUSION CRITERIA

I. Athletes presenting with irregular menstrual patterns, including amenorrhea, or diagnosed menstrual abnormalities such as polycystic ovarian syndrome (PCOS).

II. Athletes currently experiencing illness, injury, or any physiological or psychological condition that could impair menstrual function or athletic performance.

III. Athletes currently using hormonal contraceptives, such as oral contraceptives, implants, or hormonal intrauterine devices (IUDs), that suppress or modify the natural menstrual cycle.

IV. Athletes who decline or are unable to provide informed consent for study participation.

V. Athletes not currently participating in organized or competitive training sessions at the time of data collection.

3.2 MATERIALS

3.2.1 APPARTUS/INSTRUMENT

1. Menstrual Phase Tracking Tools

Calendar-Based Tracking App: A digital tool such as FLO functions as a calendar-based platform for monitoring various aspects of the menstrual cycle. Users can log details including cycle duration, the start and end dates of menstruation, and associated symptoms like mood fluctuations, breast tenderness, bloating, and cramping. By analyzing patterns from previously recorded data, the application forecasts upcoming cycle phases, such as menstruation, ovulation, and the luteal phase. Although it does not provide

direct measurement of hormonal levels, it offers an accessible and user-friendly means of observing menstrual regularity and identifying symptomatic trends over time.

Menstrual History Questionnaire: This instrument is a structured tool designed to gather comprehensive data regarding an individual's menstrual patterns and reproductive health. It is frequently employed in clinical evaluations, sports science research, gynecological assessments, and public health studies, particularly among females of reproductive age. Its validity is considered strong when the tool is grounded in clinical definitions, subjected to expert review, and refined through pilot testing.

2. Physical Performance Assessment Tools

- **Handgrip Dynamometer:** A digital handgrip dynamometer quantifies upper-body muscular strength by assessing grip force in both hands. Participants are instructed to squeeze the device with maximal effort, typically in a seated or standing position with the arm kept at the side. This method is widely recognized as a reliable means of evaluating overall muscular strength and physical capability, commonly utilized in athletic populations and clinical environments. ICC values range from .85 to .98, indicating strong device agreement, while concurrent validity is high (r = .97–.98).
- **Yo-Yo Intermittent Recovery Test:** This test measures an individual's ability to perform repeated high-intensity efforts interspersed with brief recovery periods. Participants run back and forth between two cones placed 20 meters apart, following an audio cue that progressively increases in pace. It is frequently employed to evaluate aerobic capacity,

recovery efficiency, speed, and agility—qualities particularly relevant to sports such as soccer and basketball, which demand intermittent bursts of intense activity. The test demonstrates validity for intermittent sports, showing strong correlations with VO_2max and high-intensity running ($r \approx 0.71$). Established field norms are available for diverse populations, and test-retest reliability is excellent, with ICC values ranging from 0.78 to 0.98-62% exceeding 0.90 and most above 0.80—along with coefficients of variation between 3.7% and 19%.

- **30-Meter Sprint Test:** This assessment evaluates explosive speed and acceleration over a short distance. Beginning from a static start, participants sprint 30 meters at maximum velocity. Timing is typically recorded using a stopwatch or an electronic timing system. The test provides a simple and dependable measure of rapid speed and power, particularly in athletic performance contexts. Studies consistently report high reliability, with ICC values generally falling between 0.80 and 0.94.
- **Illinois Agility Test:** This test appraises an individual's swiftness and control during rapid directional changes. It requires navigating a cone-marked course arranged in a rectangular configuration, involving sharp turns and quick movements. Performance is determined by the total time required to complete the course. Regarded as a well-established and dependable measure, it is widely used to assess agility and coordination in field environments. Content validity is high ($V = 0.93$), and it has proven effective in team sports and martial arts. Test-retest

ICC values range from 0.68 to 0.96, with inter-rater reliability reaching approximately 0.99.

- **Ruler Drop Test:** This straightforward yet reliable method measures hand-eye coordination and visual reaction speed. In this procedure, an examiner holds a ruler vertically and releases it without warning, while the participant attempts to catch it as quickly as possible with their fingers. The distance the ruler falls prior to being caught serves as an indicator of the individual's reaction time. Although widely accepted in practice, specific reliability metrics for this test are not documented.

3. Physiological Measurement Tools

- **Precision digital weighing scale:** This device provides high-accuracy measurements of body mass, supported by regular calibration against recognized reference standards to ensure consistent and trustworthy data. As such, it serves as an essential tool in athletic and clinical health assessments, facilitating the tracking of weight fluctuations, the analysis of body mass changes over time, and the evaluation of physiological responses to training regimens or health conditions.

Validity and Reliability

- The tools employed for performance evaluations are both standardized and supported by established validity evidence within the sports science literature.

- To uphold inter-rater reliability during physical performance testing, trained assessors will adhere to a rigorously defined and uniform testing protocol.

3.3 METHODS

3.3.1 RESEARCH DESIGN

This investigation employed a descriptive cross sectional design intended to objectively evaluate variations in physical performance indicators across the three distinct stages of the menstrual cycle, namely the follicular, ovulatory, and luteal phases, among female athletes. The data collection process was organized to facilitate intrasubject comparisons across the different phases of the cycle.

3.3.2 SAMPLING TECHNIQUES / SAMPLE SIZE DETERMINATION

A convenience sampling approach was utilized to select participants from athletic teams at the University of Benin. Lists of eligible athletes were obtained from the University's Sports Unit, and participants were screened using a brief questionnaire assessing menstrual history.

The sample size was determined using Slovin's formula, expressed as n equals N divided by the quantity one plus N multiplied by e squared. Given a population size of N equals 117 and a margin of error of e equals 0.05, the required sample size was calculated as follows:

n = 117 / (1 + 117(0.05^2))

n = 117 / (1 + 0.2925)

n = 117 / 1.2925

n = 90

therefore, the sample size required for this study using the Slovin's formula is approximately 90 participants.

Variables of the Study

- **Independent Variable:** Menstrual cycle phase, consisting of the follicular, ovulatory, and luteal stages.
- **Dependent Variables:**
    - **Physical performance indicators:**
        - Strength, assessed through measures such as grip strength
        - Speed, evaluated via 30 meter sprint time
        - Endurance, measured using the Yo Yo intermittent recovery test
        - Agility, determined by the Illinois Agility Test
    - **Anthropometric and physiological data:**
        - Body weight in kilograms

3.3.3 PROCEDURE OF DATA COLLECTION

All participants underwent an initial screening to confirm compliance with the established inclusion criteria. Following verification of eligibility, informed consent was obtained from each participant. A comprehensive explanation of the study's purpose, procedures, and ethical considerations was provided to every participant.

Menstrual Cycle Tracking

Participants were instructed to monitor their menstrual cycles using a combination of calendar based tracking and self-reporting methods. Guidance was provided on the following procedures:

- Recording the onset and conclusion dates of menstrual bleeding.
- Documenting associated symptoms such as pain, bloating, and fatigue.
- Estimating key cycle phases based on individual cycle regularity.

Educational sessions were conducted to promote accuracy and consistency in tracking. Classification of cycle phases was based on a conventional 28 day cycle model as follows:

- **Follicular Phase:** Days 1 through 5, corresponding to the menstrual bleeding period
- **Ovulatory Phase:** Days 13 through 15, representing the mid cycle ovulation window
- **Luteal Phase:** Days 21 through 25, encompassing the premenstrual phase

Physical Performance Testing

Each participant completed standardized physical performance assessments during each of the three menstrual phases. The following tests were administered:

- **Strength:** Measured using a digital handgrip dynamometer.

- **Endurance, Speed, and Agility:** Evaluated through the Yo Yo Intermittent Recovery Test, the 30meter sprint test, and the Illinois Agility Test, respectively.
- **Reaction Time:** Assessed using the Ruler Drop Test.
- **Body Weight:** Measured with a digital weighing scale.

Testing Conditions

- All testing sessions were scheduled at consistent times of day, either in the morning or evening, to account for circadian rhythm variations.
- Testing environments, including temperature, surface type, and lighting conditions, were maintained as uniformly as possible across all testing sessions.

Baseline and Phase Matched Data Collection

Before the initial testing session, foundational data such as age, weight, type of sport, cycle duration, and overall health status were documented. For each test aligned with a specific menstrual phase, records of performance metrics and physiological indicators were meticulously collected and associated with the relevant phase. This approach facilitated an objective evaluation of performance fluctuations in relation to hormonal variations throughout the menstrual cycle.

3.3.4 Ethical Considerations

Approval for the study was granted by the Research and Ethics Committee of the University of Benin. All participants received comprehensive information

regarding the study and provided written informed consent. Involvement in the study was voluntary, and participants retained the right to withdraw at any point without facing any consequences. The confidentiality and anonymity of all participants were upheld throughout the research. All data were stored securely and utilized exclusively for academic objectives.

3.3.5 Data Analysis

Statistical analysis was conducted using SPSS (version 26). Descriptive statistics, comprising means, standard deviations, and frequencies, were employed to summarize participant characteristics. A repeated measures ANOVA was used to examine differences in physical performance across the phases of the menstrual cycle, with Bonferroni post hoc tests applied for pairwise comparisons. Pearson correlation coefficient was utilized to explore relationships between body weight and performance outcomes. Independent t tests were conducted to compare performance between groups, such as those who tracked their cycles and those who did not. The threshold for statistical significance was established at $p<0.05$*p*<0.05.

CHAPTER FOUR

RESULTS

4.1 Preamble

This study sought to investigate how the phases of the menstrual cycle influence physical performance, symptom experiences, and self-management strategies among female athletes at the University of Benin. A total of 53 participants took part in the research.

4.1.1 Descriptive statistics of the respondents

The descriptive characteristics of the participants are summarized in Table 4.1, specifically focusing on the age at which menstruation began and the typical interval between cycles. The age at menarche ranged from 9 to 16 years, with a mean age of 12.19 years (± 1.72). The average duration between successive menstrual cycles was 26.02 days (± 1.89).

Table 4.1: Descriptive statistics of the respondents

	Range	Mean ± SD
Age of period onset (years)	9 – 16	12.19 ± 1.72
Days between periods	18 – 29	26.02 ± 1.89

4.1.2 Physical performance and body weight across menstrual cycles

Throughout the menstrual cycle, measures of physical performance exhibited notable variations, whereas body weight showed little change. Muscular strength reached its lowest point during the menstrual phase (mean = 24.20 kg), then peaked during the follicular (28.97 kg) and ovulatory phases (28.96 kg),

followed by a modest reduction in the luteal phase (28.70 kg). Endurance displayed a comparable trend, with the lowest values recorded during menstruation (474.4 m) and the highest during the follicular (616.6 m) and ovulatory phases (601.9 m), before declining again in the luteal phase (550.3 m).

Agility tended to improve outside the menstrual phase; slower times were observed during menstruation (17.07 s), whereas faster performances occurred in the follicular (16.08 s) and ovulatory (16.14 s) phases. Reaction time was fastest during the menstrual phase (0.16 s) but lengthened in the subsequent phases, reaching its maximum during ovulation (0.31 s).

In contrast, average body weight remained largely consistent across all phases, with values ranging narrowly between 66.06 kg and 66.64 kg, indicating minimal variation relative to performance metrics. These findings are summarized in Table 4.2.

Table 4.2: Descriptive statistics of Physical performance and body weight across menstrual cycles

	Range	Mean ± SD
Strength (kg)		
Menstrual Phase	20 – 28	24.20 ± 1.58
Follicular Phase	24 – 36	28.97 ± 3.17
Ovulation Phase	25 – 36	28.96 ± 2.89
Luteal Phase	24.6 – 34	28.7 ± 2.75
Endurance (m)		
Menstrual Phase	255 – 855	474.4 ± 110.1
Follicular Phase	450 – 900	616.6 ± 163.53
Ovulation Phase	400 – 900	601.85 ± 148.91
Luteal Phase	450 – 810	550.34 ± 97.57
Agility (secs)		
Menstrual Phase	15.41 – 19.02	17.07 ± 0.80
Follicular Phase	14.02 - 18.85	16.08 ± 0.90
Ovulation Phase	14.28 – 18.43	16.14 ± 0.90
Luteal Phase	14.32 – 19	16.29 ± 0.94
Reaction Time (secs)		
Menstrual Phase	0.1 – 0.9	0.16 ± 0.15
Follicular Phase	0.1 – 0.9	0.29 ± 0.33
Ovulation Phase	0.1 – 0.9	0.31 ± 0.34
Luteal Phase	0.1 – 0.9	0.29 ± 0.32
Weight (kg)		
Menstrual Phase	50 – 91	66.06 ± 8.24
Follicular Phase	50 – 91	66.09 ± 8.18
Ovulation Phase	50 – 90	66.64 ± 8.05
Luteal phase	52 – 91	66.53 ± 8.18

4.1.3 Comparison of physical performance indicators across menstrual cycle phases

Statistically significant variations were observed across all four menstrual cycle phases for each of the physical performance measures examined: strength, endurance, agility, and reaction time ($p < 0.001$ for strength, endurance, and agility; $p = 0.029$ for reaction time). These findings are summarized in Table 4.3.

Results from post-hoc comparisons revealed that levels of strength, endurance, and agility during the menstrual phase were significantly lower than those recorded in each of the other three phases ($p < 0.001$). No significant differences in strength were detected among the follicular, ovulation, and luteal phases. Regarding endurance, performance during the luteal phase was significantly diminished relative to both the follicular and ovulation phases ($p < 0.001$). For agility, the follicular phase yielded significantly poorer outcomes compared to the luteal phase ($p = 0.048$). With respect to reaction time, the menstrual phase was associated with notably slower responses than were observed during the ovulation ($p = 0.039$) and luteal phases ($p = 0.043$); however, the difference between the menstrual and follicular phases did not reach statistical significance. A detailed breakdown of these results is provided in Table 4.3.1.

Table 4.3: Effect of menstrual cycle on physical performance (Repeated Measures ANOVA)

Variable	df	F	η^2	p-value
Strength	1.552	150.145	0.743	< 0.001
Endurance	2.253	38.303	0.424	< 0.001
Agility	1.90	40.443	0.437	< 0.001
Reaction Time	3	3.079	0.056	0.029

Table 4.3.1 Bonferroni Post Hoc Analysis

Comparison	Mean Diff. (I–J)	CI (Lower, Upper)	p-value
Strength			
Menstrual – Follicular	-4.77*	-5.81, -3.73	< 0.001
Menstrual – Ovulation	-4.77*	-5.68, -3.86	< 0.001
Menstrual – Luteal	-4.50*	-5.40, -3.60	< 0.001
Follicular – Ovulation	0.00	-0.47, 0.48	1.000
Follicular – Luteal	0.27	-0.16, 0.70	0.549
Ovulation – Luteal	0.27	-0.14, 0.67	0.449
Endurance			
Menstrual – Follicular	-142.21*	-192.51, -91.91	< 0.001
Menstrual – Ovulation	-127.45*	-173.68, -81.23	< 0.001
Menstrual – Luteal	-75.94*	-114.41, -37.48	< 0.001
Follicular – Ovulation	14.76	-16.06, 45.57	1.000
Follicular – Luteal	66.26*	24.86, 107.67	< 0.001
Ovulation – Luteal	51.51*	21.31, 81.71	< 0.001
Agility			
Menstrual – Follicular	0.985*	0.650, 1.319	< 0.001
Menstrual – Ovulation	0.930*	0.586, 1.273	< 0.001
Menstrual – Luteal	0.777*	0.421, 1.134	< 0.001
Follicular – Ovulation	-0.055	-0.209, 0.1	0.056
Follicular – Luteal	-0.207*	-0.413, -0.001	0.048
Ovulation – Luteal	-0.152	-0.361, 0.057	0.076
Reaction Time			
Menstrual – Follicular	-0.136	-0.281, 0.008	0.075
Menstrual – Ovulation	-0.153*	-0.301, -0.005	0.039
Menstrual – Luteal	-0.134*	-0.265, -0.003	0.043
Follicular – Ovulation	-0.017	-0.197, 0.163	1.0
Follicular – Luteal	0.002	-0.151, 0.156	1.0
Ovulation – Luteal	0.019	-0.160, 0.199	1.0

4.1.4 Impact of Menstrual Cycle Stages on Body Weight

A significant variation in participants' body weight was observed across the four stages of the menstrual cycle, as shown in Table 4.4.

According to the post hoc analysis, no statistically significant difference in body weight was found between the menstrual and follicular phases ($p = 1.0$). In contrast, athletes exhibited considerably lower body weight during both the menstrual and follicular phases relative to the ovulation and luteal phases. These findings are displayed in Table 4.4.1.

Table 4.4: Effect of menstrual cycle on weight (Repeated Measures ANOVA)

Variable	Df	F	η^2	p-value
Weight	2.462	15.849	0.234	< 0.001

Table 4.4.1 Bonferroni Post Hoc Analysis

Comparison	Mean Diff. (I–J)	CI (Lower, Upper)	p-value
Weight			
Menstrual – Follicular	-0.038	-0.259, 0.183	1.0
Menstrual – Ovulation	-0.585*	-0.911, -0.259	< 0.001
Menstrual – Luteal	-0.472*	-0.744, -0.199	< 0.001
Follicular – Ovulation	-0.547*	-0.839, -0.256	< 0.001
Follicular – Luteal	-0.434*	-0.769, -0.099	0.005
Ovulation – Luteal	0.113	-0.170, 0.396	1.0

4.1.5 Relationship between change in weight and change in physical performance across menstrual cycle phases

There was a significant negative correlation between weight change and change in endurance from the Ovulation to Luteal phase of the menstrual cycle. This is presented in Table 4.5.

Table 4.5: Correlation between change in weight and change in physical performance

Weight	R	p-value
Menstrual – Follicular		
Strength	-0.125	0.374
Endurance	0.255	0.065
Agility	-0.178	0.203
Reaction Time	0.118	0.398
Follicular – Ovulation		
Strength	-0.086	0.542
Endurance	-0.101	0.473
Agility	-0.056	0.69
Reaction Time	0.015	0.914
Ovulation – Luteal		
Strength	0.224	0.107
Endurance	-0.313	0.023
Agility	-0.002	0.988
Reaction Time	-0.002	0.986

4.1.6 Menstrual-Related Symptoms Reported by Participants

Among the symptoms reported during the menstrual phase, cramps were the most prevalent, affecting 60.4% of respondents, whereas cravings and chills were the least frequently cited, each at 1.9%. During the follicular phase, the majority of participants (67.9%) reported heightened strength, energy, or endurance, while irritability, diminished strength, and restlessness were the least commonly reported, each at 1.9%. Bloating was the predominant symptom during ovulation, reported by 52.8% of respondents, with reduced appetite being the least frequently noted at 1.9%. In the luteal phase, irritability or moodiness emerged as the most frequently reported symptom (39.6%), while reduced appetite and reduced energy were the least common, each accounting for 1.9% of responses. These findings are presented in Table 4.5.

Table 4.6: Menstrual-related symptoms reported by the respondents

	Frequency	Percentage
Menstrual Phase		
Cramps	32	60.4
Fatigue/Low Energy	28	52.8
Body Pain	16	30.2
Moody/Irritable	11	20.8
No Symptoms	7	13.2
Reduced Appetite	3	5.7
Cravings	1	1.9
Other (Chills)	1	1.9
Follicular phase		
Increased strength/energy/endurance	36	67.9
Increased appetite/cravings	16	30.2
Neutral/No change	15	28.3
Fatigue/Low Energy	2	3.8
Improved mood	2	3.8
Irritability	1	1.9
Reduced strength	1	1.9
Restless	1	1.9
Ovulation phase		
Bloating	28	52.8
Increased appetite/cravings	27	50.9
Neutral	12	22.6
Tender breast	11	20.8
Increased energy/endurance	9	17.0
Ovulation pain/cramps	9	17.0
Fatigue/Reduced energy	4	7.5
Irritable/Moody	3	5.7
Reduced appetite	1	1.9
Luteal phase		
Irritable/Moody	21	39.6
Neutral	14	26.4
Increased energy/Restless	13	24.5
Lack of motivation	11	20.8
Increased appetite	6	11.3
Reduced energy/Sluggish/Tired	4	7.5
Bloating	2	3.8
Reduced appetite	1	1.9
Reduced energy	1	1.9

4.2: Hypothesis Testing

Hypothesis 1: There would be no significant difference in specific types of physical performance (e.g., strength, speed, endurance, agility) across the menstrual, follicular, ovulatory, and luteal phases among female athletes.

Alpha level: 0.05

Test statistic: Repeated Measures ANOVA

Observed: $p < 0.05$

Since the observed p value was lesser than 0.05 Alpha level. The null hypothesis was therefore REJECTED.

Hypothesis 2: There would be no significant difference in body weight across the menstrual, follicular, ovulatory, and luteal phases among female athletes.

Alpha level: 0.05

Test statistic: Repeated Measures ANOVA

Observed: $p < 0.05$

Since the observed p value was lesser than 0.05 Alpha level. The null hypothesis was therefore REJECTED.

Hypothesis 3: There would be no significant relationship between the variation in body weight and variation in physical performance across different menstrual cycle phases

Alpha level: 0.05

Test statistic: Pearson's correlation

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The null hypothesis was therefore NOT REJECTED.

Hypothesis 4: There would be no significant relationship between the variation in body weight and variation in endurance across between the ovulation and luteal phase

Alpha level: 0.05

Test statistic: Pearson's correlation

Observed: $p < 0.05$

Since the observed p value was lesser than 0.05 Alpha level. The null hypothesis was therefore REJECTED.

CHAPTER FIVE

DISCUSSION, CONCLUSION, RECOMMENDATION AND IMPLICATIONS

5.1 DISCUSSION

This study sought to assess how phases of the menstrual cycle influence physical performance in female athletes at the University of Benin. The findings indicated that participants experienced menarche between the ages of 9 and 16 years, with intermenstrual intervals averaging 18 to 29 days. Notable differences in physical performance indicators were observed across the various phases of the cycle. These results align with those reported by Meignie et al. (2021) and Solli et al. (2020), whose work similarly demonstrated that menstrual cycle phases can affect athletic performance in females. Such outcomes may be attributed to the physiological fluctuations, particularly hormonal changes, that characterize the menstrual cycle.

In contrast, studies by Kishali et al. (2006) and Cunha et al. (2021) reached differing conclusions, reporting that menstrual cycle phases did not significantly influence physical performance and that pain levels diminished during training and competition. A possible explanation for the discrepancy lies in the methodological approach of Kishali et al. (2006), which relied predominantly on self reported questionnaire data rather than objective measurements of physical performance across distinct cycle phases.

Regarding the relationship between physical performance and body weight across the menstrual cycle, performance was observed to vary while body

weight remained comparatively stable. This supports the findings of Solli et al. (2020), who noted performance fluctuations in athletes. The relative stability of body weight suggests that it exerts minimal influence on physical performance outcomes.

Nonetheless, the present study revealed that body weight was indeed affected by menstrual cycle phase, with lower readings recorded during the menstrual and follicular phases and elevated readings during the ovulatory and luteal phases. This pattern is consistent with observations by Stachoń (2016), who noted that although such weight changes are typically modest, often under 1 kg, they represent a meaningful consideration for female athletes, particularly those competing in weight class sports where slight variations in body mass and composition can affect performance. Supporting this, participants in the current study reported reduced appetite during the menstrual phase coinciding with weight loss, and bloating alongside increased appetite or cravings during the ovulatory phase coinciding with weight gain. Furthermore, the negative correlation observed between weight fluctuation and endurance changes from the ovulatory to luteal phase indicates that an increase in weight during either phase corresponds with a decrease in endurance, and the reverse also holds true.

Each physical performance indicator, including strength, endurance, agility, and reaction time, demonstrated significant variation across cycle phases. Performance was lowest during the menstrual phase, while improvements were observed during the follicular and ovulatory phases. This finding is consistent with Solli et al. (2020), who reported that approximately 50 percent and 71 percent of participants experienced improved and reduced physical fitness,

respectively, during specific menstrual cycle phases, with most athletes reporting their poorest fitness, performance, and side effects during the bleeding phase. This may be explained by the intensity of cramps and fatigue experienced during this phase, which can negatively affect physical performance. These observations further corroborate the menstrual related symptoms reported by participants, which included cramps, pain, and fatigue during the menstrual phase; improved strength and mood during the follicular phase; bloating during the ovulatory phase; and irritability during the luteal phase. This aligns with the findings of Ihalajnen et al. (2024), who similarly reported that menstrual cycle phases influence physical performance and that perceived mental performance, encompassing mood and attention, appeared to be most affected among female athletes.

Approximately 40 percent of athletes did not track their menstrual cycles, yet all were aware of the impact their cycles had on physical performance. This awareness was evident during training sessions, where athletes moved sluggishly during the menstrual phase due to cramps and pain, and displayed increased energy during the follicular and ovulatory phases. Among those who did track their cycles, the practice was not correlated with performance adaptation but rather served to anticipate and predict the timing of their periods. Notably, the coaches of these athletes were unaware of the influence the menstrual cycle had on their athletes and had not implemented any training adjustments in response to cycle phases. This lack of awareness may stem from the fact that athletes did not actively discuss their periods with their coaches. It should be noted that this aspect of the study was assessed subjectively through discussions with athletes and coaches rather than through objective measures.

5.2 CONCLUSION

The findings of this research demonstrate that the phases of the menstrual cycle exert a considerable influence on the physical performance of female athletes at the University of Benin. The results challenge the efficacy of a uniform training methodology, affirming that such an approach fails to account for the distinct physiological fluctuations inherent to female athletes. Given that performance outcomes demonstrably vary in accordance with menstrual cycle phase, training regimens must be tailored to the individual's cycle.

5.3 RECOMMENDATIONS

i. Female athletes ought to receive education regarding the effects of the menstrual cycle on their physical performance.

ii. Although this study did not conduct a formal assessment of coaches' awareness concerning the influence of menstrual cycle phases on their female athletes' performance, informal observation and discussions indicated a general lack of awareness on the matter. It is therefore recommended that coaches be provided with education on how the menstrual cycle affects athletic performance, with the aim of both reducing injury risk and facilitating the development of individualized training plans.

iii. This research similarly did not formally evaluate the prevalence of menstrual cycle tracking among participants. However, it was observed that approximately half of the athletes were actively tracking their cycles, a practice that facilitated data collection. Those who were not engaging in tracking are advised to adopt this practice.

iv. Athletes who experience severe symptoms should be encouraged to seek medical attention at a clinic or hospital.

v. Nutritional recommendations include increasing iron intake during the menstrual phase and maintaining heightened hydration during both the follicular and luteal phases.

vi. Training sessions should incorporate open and confidential discussions between coaches and athletes regarding the menstrual cycle and its effects on physical performance.

5.4 IMPLICATIONS FOR FUTURE RESEARCH

i. A cross-sectional investigation should be undertaken involving athletes who consistently monitor their menstrual cycles and modify their training regimens in response to the different phases.

ii. Research is required to assess the extent of coaches' knowledge, as well as their perceptions regarding how menstrual cycle phases influence the athletic performance of those under their supervision.

iii. An examination exploring the disparities in performance stability between athletes who experience regular menstrual cycles and those with irregular cycles would be valuable.

iv. Further inquiry should focus on identifying the obstacles that deter athletes from openly communicating menstruation-related issues with their coaches.

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APPENDIX 1

INFORMED CONSENT

My name is IMARHIAGBE-LEO GRACE IMOSE, a final year student of the Department of Physiotherapy, College of Basic Medical Science, University of Benin, Benin city, Edo State. I am carrying out a research titled “IMAPCT OF MENSTRUAL CYCLE OHASES ON THE PHYSICAL PERFORMANCE OF UNIBEN FEMALE-STUDENT ATHLETES”. This research study would be conducted as part of the requirement for the award of Bachelor of Physiotherapy (B.PT). Your participation is voluntary and you are free to ask questions about the study and you are also free to withdraw at any time you desire. Your response would be strictly confidential and would be used solely for the purpose of this research. Please kindly include your signature and date if you are willing to participate.

Participants signature **Researchers signature**

…….. **……..**

APPENDIX 2

P:\FERNALD\Questionnaires\2007 Menstrual History Questionnaire.doc

Menstrual History Questionnaire

1. How old were you when you started having menstrual periods?

Age: _____ 1a. If you cannot remember your exact age, were you:

† Younger than 10 † 16 or older

† 10-12 yrs old † Don't Know

† 13-15 yrs old

2. At present which statement best describes your menstrual cycle?

† I'm still having regular periods: The date of my last period was: ___/___/_____

† My periods are irregular: The date of my last period was: ___/___/_____

† I'm pregnant, or my last pregnancy ended within the past 2 months,

or I'm breast feeding

† My periods have stopped on their own. (I've had menopause.)

† I've had menopause, but now have periods because I am taking hormones.

† I've had an operation (surgery) which stopped my periods.

If your menstrual periods ceased because of surgery, what did you have

removed?

† One ovary only † Uterus only

† Both ovaries † Uterus and one ovary

† Uterus and both ovaries

† Don't know

† I've taken medication which has stopped my periods.

If your periods stopped because of medication, which medication were you taking? Medication name: _____

† I"ve had chemotherapy which has stopped my periods.

† I've had radiation therapy which has stopped my periods.

† Other: _____

3. If your menstrual periods have stopped, how old were you when your menstrual periods stopped? (Please provide us with the age at which your menstrual periods stopped regardless of why they have stopped – naturally, due to surgery, medication, chemotherapy, or radiation therapy. If your periods have stopped, but you now have periods because of taking hormones, answer with the age at which your periods first stopped.)

Were you: † Younger than 20 † 45-49 yrs old

† 20-29 yrs old † 50-54 yrs old

† 30-39 yrs old † 55 – 59 yrs old

† 40-44 yrs old † 60 or older

OR † My menstrual periods have not stopped.

4. If your menstrual periods have stopped, how old were you when you first experienced symptoms of menopause such as hot flashes or night sweats?

_____ Years old † Did not experience symptoms

† Don't Know

OR † My menstrual periods have not stopped.

All women should answer the next two questions, whether they currently have menstrual periods or not.

5. When you are (were) having regular menstrual cycles, how many days are (were)

there between periods? _____ Days between periods

For how many days do (did) you have your period? _____ Days

6. Between the ages of 18 and 40, excluding times when you may have been on the

pill, pregnant, or nursing, which of the following statements BEST describes your

menstrual periods? They are (were)…

† Nearly always regular, that is, you could usually predict when you would start bleeding to within two or three days

† Fairly Regular

† Irregular

† Don’t Know