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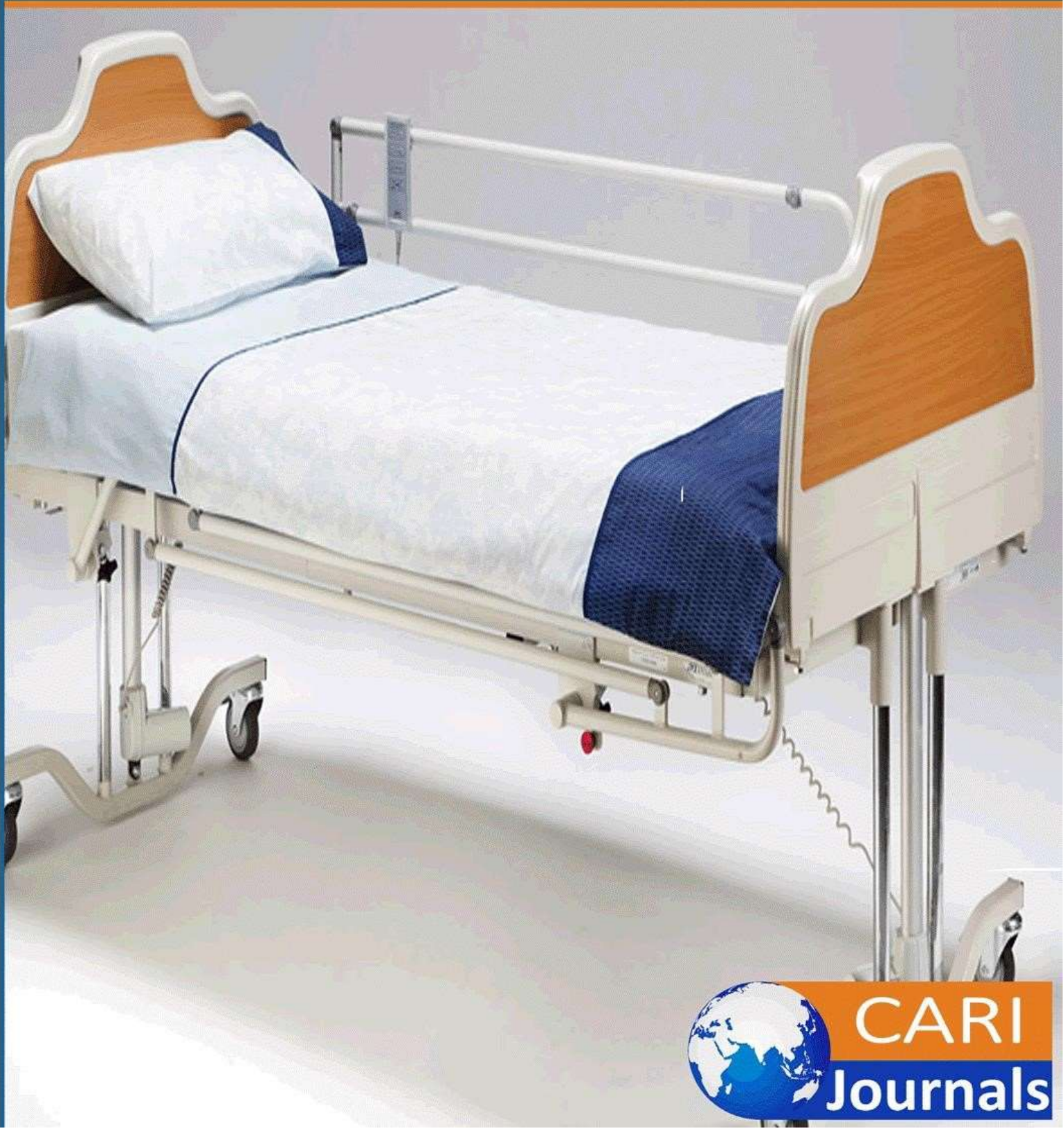

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Menstrual Cycle Phases, Symptom Variability, and Exercise Behaviour Among Female Students and Teachers at a Secondary School in Bonaberi, Douala, Cameroon: A Cross-Sectional Survey

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ABSTRACT

Purpose: This study examined the physical and emotional symptoms experienced by female students and teachers across menstrual cycle phases, assessed the influence of these phases on exercise participation and preferences, and explored perceptions of exercise during menstruation at Lycée Government Bilingual High School (G.B.H.S.) Bojongo Bonaberi, Douala, Cameroon.

Methods: A descriptive cross-sectional survey was conducted among 300 purposively selected female participants (274 students aged 15–21 years and 26 teachers aged 25–45 years). Data were collected via structured face-to-face interview guides and analysed using IBM SPSS v27; results are presented as frequencies and percentages.

Findings: The majority of participants (67.0%) were aged 15–19 years; 75.0% reported regular menstrual cycles. Dysmenorrhoea was the predominant physical symptom (69.0%), peaking during the menstrual phase (75.0%), with moderate functional impairment in 71.0% of cases. Sadness (70.0%) and mood swings (25.0%) were the dominant emotional symptoms, moderately deterring exercise in 69.0% of respondents. Although 77.0% engaged in regular exercise, 70.0% reported that participation was symptom-contingent. The follicular phase was strongly preferred for exercise (71.0%). While 70.0% held positive beliefs about exercise during menstruation, 42.0% reported cultural or social influences discouraging physical activity.

Unique Contribution to Theory, Practice, and Policy: This study provides the first contextually grounded, school-based evidence on the intersection of menstrual symptom variability, hormonal physiology, and exercise behaviour in Cameroon. The findings advance theoretical understanding of the socio-ecological determinants of menstrual health behaviour in sub-Saharan Africa and provide a practical evidence base for designing physiologically grounded, culturally sensitive menstrual health education programmes. Policymakers are urged to integrate cycle-informed physical activity guidance into national school health curricula, and to address cultural misconceptions through community-level interventions involving families, educators, and health professionals.

Keywords: *Menstrual Cycle Phases; Dysmenorrhoea; Exercise Behaviour; Hormonal Fluctuation; Menstrual Health; Adolescents; Cameroon; Sub-Saharan Africa.*

1. INTRODUCTION

The menstrual cycle is a fundamental physiological process in women of reproductive age, typically spanning 28 days and regulated by cyclical changes in the hypothalamic-pituitary-gonadal axis. The resulting oscillations of oestrogen (17β-oestradiol) and progesterone exert pervasive effects across multiple physiological systems including the cardiovascular, neuromuscular, metabolic, thermoregulatory, and neuropsychological systems and are thus directly relevant to exercise performance, symptom experience, and physical activity behaviour (Reed & Carr, 2023; Elorduy-Terrado et al., 2025). The cycle is conventionally divided into four phases: the menstrual phase (days 1–5), the follicular phase (days 6–14), the ovulatory phase (approximately day 14), and the luteal phase (days 15–28), each characterised by a distinct hormonal profile (McNulty et al., 2020).

Globally, dysmenorrhoea (painful menstruation) affects an estimated 50–90% of menstruating women and is the most common gynaecological complaint among adolescent girls (Armour et al., 2021). Beyond pain, menstrual-phase symptoms including fatigue, bloating, and mood disturbances substantially impair daily functioning and physical activity participation (Armour et al., 2021). In sub-Saharan Africa, including Cameroon, dysmenorrhoea has been documented as a major cause of school absenteeism and reduced quality of life. A cross-sectional study in Yaoundé, Cameroon, reported a dysmenorrhoea prevalence of 71.2% among adolescent schoolgirls, with daily activity disruption in over 70% of affected individuals (Mboua et al., 2023). A cross-sectional study conducted across five secondary schools in Douala from October 2023 to April 2024, enrolling 1,045 adolescent girls aged 13–19 years, confirmed this high prevalence and highlighted the severity of primary dysmenorrhoea and its functional consequences in this setting (Bih et al., 2025).

Despite a growing evidence base on the relationship between menstrual cycle phases and exercise performance in high-income contexts, data from secondary school populations in low- and middle-income countries (LMICs) are markedly limited. A global scoping review of 86 studies spanning 33 countries, published in *BMC Women's Health* (2025), identified a bidirectional relationship between menstruation and physical activity: menstruation acts as a barrier to activity through symptoms, while physical activity may modulate symptom severity (Jouannin et al., 2025). However, the review noted an underrepresentation of African school-based studies, emphasising the need for contextually relevant research. Concurrently, cultural beliefs, menstrual stigma, and family influences in African settings have been identified as additional significant barriers to exercise during menstruation, operating independently of physical symptoms (Fennie et al., 2022; Frontiers in Reproductive Health, 2025).

Evidence-based literature consistently demonstrates that regular exercise, particularly aerobic and yoga-based activity, reduces dysmenorrhoea severity, alleviates premenstrual symptoms, and improves physical and emotional well-being (Matthewman et al., 2022; Pathak & Shukla, 2023). The follicular phase, characterised by rising oestradiol and low progesterone, represents the physiologically optimal window for high-intensity exercise, while the menstrual phase's prostaglandin-driven uterine contractions and fatigue create barriers to participation (Elorduy-

Terrado et al., 2025; Bruinvels et al., 2017). Yet, the intersection of hormonal physiology, symptom experience, cultural belief, and exercise behaviour has not been examined in the specific context of secondary school communities in Douala, Cameroon.

This study aims to address this gap by examining: (1) the physical and emotional symptoms experienced by female secondary school students and teachers across menstrual cycle phases; (2) the influence of cycle phase on exercise participation and phase preference; and (3) perceptions of exercise benefits, cultural influences, and coping strategies during menstruation. The findings are intended to inform nurse educators, school health officers, and policymakers in designing targeted, physiologically grounded, and culturally sensitive menstrual health education programmes in Cameroon and comparable sub-Saharan African settings.

2. LITERATURE REVIEW

2.1 Physiology of the Menstrual Cycle Phases

The menstrual cycle is orchestrated by a finely tuned hormonal cascade involving the hypothalamic-pituitary-gonadal axis. In the menstrual phase (days 1–5), the concurrent nadir of oestradiol (<20 pg/mL) and progesterone (<1 ng/mL) results in endometrial shedding mediated by prostaglandin F2α (PGF2α). Elevated uterine PGF2α stimulates myometrial hyper-contractility and ischaemia, producing the characteristic cramping pain of primary dysmenorrhoea (Iacovides et al., 2015). Concurrently, declining β-endorphin levels reduce central pain modulation, increasing pain sensitivity (Armour et al., 2021). Iron loss from menstrual bleeding further compounds fatigue through reduced oxygen-carrying capacity.

The follicular phase (days 6–14) is characterised by progressive increases in follicle-stimulating hormone (FSH) and a consequent rise in oestradiol to approximately 200–400 pg/mL at its peak. Oestrogen exerts a broad array of anabolic and performance-enhancing effects: it enhances glycogenolysis, improves insulin sensitivity, upregulates satellite cell activity in skeletal muscle, and increases serotonin synthesis, collectively improving energy, mood, strength, and exercise tolerance (Kissow et al., 2022; Elorduy-Terrado et al., 2025). A systematic review with meta-analysis of 22 studies involving 433 women confirmed medium-effect-size advantages in isometric maximal strength during the late follicular phase relative to other phases (Hillebrecht et al., 2024). This makes the follicular phase the physiologically optimal window for high-intensity physical activity.

At ovulation (approximately day 14), a luteinising hormone (LH) surge triggers follicular rupture. Peak oestradiol enhances neuromuscular coordination and power output but concurrently activates collagenase enzymes that reduce ligamentous stiffness by 10–20%, particularly at the anterior cruciate ligament (ACL) and shoulder, elevating injury risk during dynamic pivoting activities (Smith et al., 2019; Elorduy-Terrado et al., 2025). The luteal phase (days 15–28) is dominated by progesterone (10–20 ng/mL), which elevates basal metabolic rate (+5–10%), core temperature (+0.3–0.5°C), and the respiratory exchange ratio. While fat oxidation increases, carbohydrate metabolism is impaired because progesterone acts as an oestrogen antagonist in muscle glucose uptake, potentially reducing high-intensity exercise capacity (Burchill, 2025). Progesterone and its metabolite allopregnanolone modulate GABA-

A receptors in the central nervous system; declining oestrogen in the late luteal phase reduces serotonin synthesis, contributing to mood lability, irritability, anxiety, and sadness characteristic of premenstrual syndrome (PMS) (Hantsoo & Epperson, 2021; Benarroch et al., 2024).

2.2 Physical and Emotional Symptom Variability Across Cycle Phases

Symptoms across the menstrual cycle reflect the underlying hormonal milieu. Primary dysmenorrhoea, affecting 50–90% of menstruating women globally (Armour et al., 2021), is predominantly a menstrual-phase phenomenon driven by excessive PGF2α synthesis. A large-scale study in Douala (n = 1,045) confirmed this pattern, with lower abdominal cramping and fatigue as the most prevalent and disabling menstrual-phase symptoms (Bih et al., 2025). During the follicular phase, symptom burden abates markedly as rising oestradiol stabilises mood, restores energy, and enhances pain tolerance via upregulated serotonin and β-endorphin activity (Wen et al., 2025). Luteal-phase symptoms including bloating, mastalgia, mood swings, irritability, and sadness are driven by the interplay between progesterone, declining oestrogen, and their downstream effects on GABA-ergic and serotonergic neurotransmission (Hantsoo & Epperson, 2021; Benarroch et al., 2024). Severe PMS, affecting 20–40% of reproductive-age women, represents a clinically significant amplification of these late-luteal neurobiological changes.

2.3 Menstrual Cycle Phases and Exercise Participation

Evidence consistently demonstrates that exercise participation is phase-dependent. The follicular phase, with its favourable hormonal profile, is associated with greater exercise motivation, capacity, and performance, while the menstrual and late luteal phases are associated with reduced participation due to symptom burden and low mood (McNulty et al., 2020; Jouannin et al., 2025). A global scoping review of 86 adolescent-focused studies confirmed that menstruation acts as a barrier to physical activity due to symptoms, fear of leakage, lack of facilities, and cultural taboos, while regular physical activity in turn modulates menstrual symptoms (Jouannin et al., 2025). Armour et al. (2021) and Matthewman et al. (2022) documented that women who exercise regularly report fewer and less severe dysmenorrhoea symptoms. A systematic review of exercise interventions confirmed that aerobic and yoga-based training significantly reduced dysmenorrhoea pain scores compared to controls, with the greatest benefit from programmes of eight weeks or more (Matthewman et al., 2022).

2.4 Exercise as a Physiological Modulator of Menstrual Symptoms

The mechanisms by which exercise alleviates menstrual symptoms are multifactorial and physiologically well characterised. Aerobic exercise stimulates pituitary release of β-endorphins, which bind opioid receptors in the central nervous system to raise the pain threshold and suppress the afferent transmission of prostaglandin-mediated uterine pain signals (Daley, 2009; Matthewman et al., 2022). Exercise also promotes uterine vasodilatation and pelvic blood flow, counteracting the ischaemia responsible for cramping. Furthermore, aerobic activity suppresses cyclooxygenase-2 (COX-2) activity, thereby reducing uterine PGF2α

synthesis at its source (Iacovides et al., 2015). Mood benefits arise from exercise-induced upregulation of brain-derived neurotrophic factor (BDNF) and monoamine oxidase inhibition, which augment serotonin and dopamine levels, counteracting the neurotransmitter depletion of the late luteal phase (Armour et al., 2021). Improved lymphatic drainage from moderate aerobic activity reduces bloating, and enhanced parasympathetic tone promotes restorative sleep architecture, counteracting the sleep disruption of the luteal phase (Bruinvels et al., 2017).

2.5 Cultural Influences and Perceptions of Exercise During Menstruation

In addition to physiological barriers, cultural beliefs and social norms significantly shape exercise behaviour during menstruation. In many African and other low- and middle-income country settings, cultural restrictions, menstrual stigma, and family discouragement create barriers to physical activity during menstruation, operating independently of symptom severity (Fennie et al., 2022; Frontiers in Reproductive Health, 2025). Women who receive education about menstrual health and the benefits of exercise are more likely to maintain physical activity throughout the cycle (Armour et al., 2021). Targeted health education that addresses both the physiological rationale for exercise and the cultural misconceptions surrounding it is therefore essential for promoting healthy exercise behaviour in school settings.

3. MATERIALS AND METHODS

3.1 Study Design and Setting

A descriptive cross-sectional survey design was employed, as it was appropriate for characterising the current state of symptom experience, exercise behaviour, and perceptions at a single point in time across the study population. The study was conducted at Lycée Government Bilingual High School (G.B.H.S.) of Bojongo Bonaberi, Douala, Cameroon, an institution comprising both female students and female teachers with diverse age profiles. Douala, the economic capital of Cameroon, was selected given its documented high burden of primary dysmenorrhoea among adolescent girls (Bih et al., 2025).

3.2 Study Population, Sample Size, and Sampling

The target population comprised all female students and teachers at the study institution with regular or irregular menstrual cycles who were of reproductive age. The sample size was estimated using Yamane's formula (Yamane, 1967): $n = N / (1 + N(e)^2)$, where N = 525 (total female population) and e = 0.05 (margin of error at 95% confidence level), yielding n = 300. A purposive sampling strategy was employed to enrol participants with direct experience of the phenomena under study specifically, females experiencing menstrual cycles. A total of 300 participants (274 students aged 15–21 years and 26 teachers aged 25–45 years) were enrolled. Inclusion criteria required participants to be female, currently menstruating, and willing to provide informed consent. Post-menopausal women, women with diagnosed gynaecological conditions (other than primary dysmenorrhoea) affecting menstruation, and those unwilling to participate were excluded.

3.3 Data Collection Tool and Procedure

Data were collected using a structured, pre-tested interview guide administered face-to-face in a private room at the school to ensure confidentiality. The guide comprised five sections: (A) socio-demographic characteristics; (B) physical symptoms across cycle phases; (C) emotional and psychological symptoms; (D) exercise participation and cycle-phase preferences; and (E) perceptions, cultural influences, and coping strategies regarding exercise during menstruation. The tool was pre-tested on a pilot group of ten females outside the main study population to assess clarity and face validity. Interviews lasted 10–15 minutes each. Audio recordings were made with participant consent and transcribed immediately after each session for accuracy.

3.4 Data Management and Analysis

Completed interview transcripts were coded, entered into Microsoft Excel 2019, cleaned for errors and inconsistencies, and transferred to IBM SPSS Statistics v27 for analysis. Categorical variables are presented as frequencies and percentages. Where appropriate, the Pearson chi-square (χ^2) test was used to assess associations between categorical variables at a significance level of $p < 0.05$. Results are presented in frequency distribution tables.

3.5 Ethical Considerations

Administrative authorisation was obtained from the Principal of Lycée G.B.H.S. Bojongo Bonaberi, and institutional approval was obtained from STEM Higher Institute of Health and Technological Sciences prior to data collection. Written informed consent was obtained from all adult participants. For minor students (aged 15–17 years), parental or guardian assent was obtained in addition to participant assent. Participation was entirely voluntary, anonymous, and withdrawable at any time without consequences. Confidentiality was maintained by replacing participant identifiers with codes throughout the study. All procedures were conducted in accordance with the Declaration of Helsinki.

4. FINDINGS

4.1 Socio-Demographic Characteristics

A total of 300 female participants were enrolled. Their socio-demographic profile is presented in Table 1. The majority (67.0%, n = 201) were aged 15–19 years, reflecting the predominantly secondary school sample composition. Students constituted 82.0% (n = 246) of participants and teachers 18.0% (n = 54). Most participants (82.0%) were single, and 75.0% reported a regular menstrual cycle, while 15.0% reported irregular cycles.

Table 1 Socio-Demographic Characteristics of Study Participants (N = 300)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	15–19	201	67.0
	20–24	27	9.0
	25–29	42	14.0
	30–34	21	7.0
	35+	9	3.0
	Total	300	100.0
Occupation	Student	246	82.0
	Teacher	54	18.0
	Total	300	100.0
Marital Status	Single	246	82.0
	Married	54	18.0
	Total	300	100.0
Menstrual Cycle Regularity	Regular	225	75.0
	Irregular	45	15.0
	Not sure	30	10.0
	Total	300	100.0

Lycée G.B.H.S. Bojongo Bonaberi, Douala, Cameroon.

4.2 Objective 1: Physical and Emotional Symptoms Across Menstrual Cycle Phases

4.2.1 Physical Symptoms

Table 2 presents the physical symptoms experienced across the menstrual cycle. Dysmenorrhoea (lower abdominal cramps) was the most prevalent physical symptom, reported by 69.0% (n = 207) of respondents. The menstrual phase was identified as the phase of maximum symptom severity by 75.0% (n = 225) of participants, reinforcing cramps as the defining feature of this phase. Symptoms moderately affected daily activities in 71.0% (n = 213) of respondents, with an additional 11.0% (n = 33) reporting severe functional impairment. Only 7.0% (n = 21) reported no effect on daily activities.

Table 2 Physical Symptoms Experienced During the Menstrual Cycle (N = 300)

Variable	Category	Frequency (n)	Percentage (%)
Most common physical symptom	Cramps (lower abdominal pain)	207	69.0
	Fatigue	21	7.0
	Bloating	21	7.0
	Back pain	21	7.0
	Headache	9	3.0
	No symptoms	21	7.0
Phase of maximum symptom severity	Menstrual phase	225	75.0
	Ovulatory phase	24	8.0
	No difference	27	9.0
	Follicular phase	12	4.0
	Luteal phase	12	4.0
Effect of symptoms on daily activities	Moderately	213	71.0
	Severely	33	11.0
	Mildly	33	11.0
	Not at all	21	7.0
	Total	300	100.0

4.2.2 Emotional Symptoms

Table 3 presents the emotional symptoms. Sadness was the dominant emotional change, reported by 70.0% (n = 210) of respondents, followed by mood swings in 25.0% (n = 75), low motivation in 3.0% (n = 9), and anxiety in 2.0% (n = 6). Emotional changes moderately affected exercise participation in 69.0% (n = 207) of cases, with 10.0% (n = 30) reporting that emotional changes greatly deterred participation.

Table 3 Emotional Symptoms Experienced During the Menstrual Cycle (N = 300)

Variable	Category	Frequency (n)	Percentage (%)
Dominant emotional/mood change	Sadness	210	70.0
	Mood swings	75	25.0
	Low motivation	9	3.0
	Anxiety	6	2.0
	Total	300	100.0
Effect of emotional changes on exercise participation	Moderately	207	69.0
	Not at all	45	15.0
	Greatly	30	10.0
	Slightly	18	6.0
	Total	300	100.0

4.3 Objective 2: Effect of Menstrual Cycle Phases on Exercise Participation

Table 4 presents exercise participation data and the influence of menstrual cycle phases. The majority (77.0%, n = 231) engaged in regular physical activity; walking (24.0%), yoga (22.0%), household physical work (20.0%), running (19.0%), and light strength training (15.0%) were the most common modalities. Exercise behaviour was predominantly symptom-contingent: 70.0% (n = 210) indicated that their participation depended on how they felt during a given phase, while 15.0% (n = 45) reported reduced participation. Only 8.0% reported increased participation. The follicular phase was strongly preferred for exercise by 71.0% (n = 213) of respondents, followed by the ovulatory phase (10.0%, n = 30). The menstrual phase was preferred by only 6.0% (n = 18) and the luteal phase by 4.0% (n = 12).

Table 4 Exercise Participation Patterns and Influence of Menstrual Cycle Phases (N = 300)

Variable	Category	Frequency (n)	Percentage (%)
Engages in regular exercise	Yes	231	77.0
	No	69	23.0
	Total	300	100.0
Type of exercise (among exercisers)	Walking	72	24.0
	Yoga	66	22.0
	Household physical work	60	20.0
	Running	57	19.0
	Light strength training	45	15.0
How menstrual cycle affects exercise	Depends on symptoms	210	70.0
	Reduced participation	45	15.0
	Increased participation	24	8.0
	No effect	21	7.0
	Total	300	100.0
Preferred phase for exercise	Follicular phase	213	71.0
	Ovulatory phase	30	10.0
	No difference	27	9.0
	Menstrual phase	18	6.0
	Luteal phase	12	4.0
	Total	300	100.0

Multiple responses were permitted for exercise type.

4.4 Objective 3: Perceptions of Exercise, Cultural Influences, and Coping Strategies

Table 5 presents participants' perceptions of exercise during menstruation, cultural influences, and coping strategies. The majority (70.0%, n = 210) believed exercise during menstruation to be beneficial, while 13.0% were uncertain, 10.0% considered it safe but uncomfortable, and 7.0% believed it to be harmful. Regarding cultural and social influences, 58.0% (n = 174) reported no cultural barrier to exercise. However, 18.0% (n = 54) reported that friends influenced their participation, 14.0% (n = 42) reported family discouragement, and 10.0% (n = 30) cited cultural restrictions. Rest combined with hydration was the dominant coping strategy (58.0%, n = 174). Pain medication was used by only 6.0% (n = 18), and heat therapy by 4.0% (n = 12).

Table 5 Perceptions of Exercise During Menstruation, Cultural Influences, and Coping Strategies (N = 300)

Variable	Category	Frequency (n)	Percentage (%)
Perception of exercise during menstruation	Beneficial	210	70.0
	Not sure	39	13.0
	Safe but uncomfortable	30	10.0
	Harmful	21	7.0
	Total	300	100.0
Cultural/social influences on exercise	No influence	174	58.0
	Friends influence participation	54	18.0
	Family discourages exercise	42	14.0
	Cultural restrictions	30	10.0
	Total	300	100.0
Primary coping strategy during exercise	Rest combined with hydration	174	58.0
	Light exercise	24	8.0
	Hydration only	21	7.0
	Pain medication	18	6.0
	Rest and light exercise	15	5.0
	Rest only	15	5.0
	No strategy	15	5.0
	Heat therapy	12	4.0
	Other combinations	6	2.0
	Total	300	100.0

Multiple responses were permitted for coping strategies.

5. DISCUSSION

This study provides baseline data on menstrual symptom variability, exercise behaviour, and perceptions among female secondary school participants in Douala, Cameroon a population for which contextually specific evidence has been scarce. The findings consistently align with the established hormonal physiology of the menstrual cycle and with recent African and global evidence, while revealing important local cultural determinants.

5.1 Predominance of Dysmenorrhoea and Menstrual-Phase Symptom Burden: Physiological Explanation

The finding that dysmenorrhoea (lower abdominal cramps) was the most prevalent physical symptom (69.0%), peaking in severity during the menstrual phase (75.0%), is physiologically predicted by the hormonal events of this phase. As oestradiol and progesterone simultaneously drop to their nadir at the end of the luteal phase, the endometrium undergoes programmed apoptosis, triggering the release of arachidonic acid from cell membrane phospholipids. Phospholipase A2 converts arachidonic acid to prostaglandin precursors, which are subsequently metabolised by cyclooxygenase-2 (COX-2) to prostaglandin F2α (PGF2α) and prostaglandin E2 (PGE2). These prostaglandins bind myometrial smooth muscle receptors, stimulating intense uterine contractions that compress uterine blood vessels, producing transient myometrial ischaemia and hypoxia, the direct source of cramping pain (Iacovides et al., 2015). Women with primary dysmenorrhoea have been shown to produce 3–5 times more PGF2α than asymptomatic women during the first 48 hours of menstruation. This mechanism explains why cramps are most intense on days 1–2, as documented in this and other studies (Armour et al., 2021). The high prevalence of dysmenorrhoea in this predominantly adolescent sample (67.0% aged 15–19) is consistent with epidemiological evidence that primary dysmenorrhoea peaks during adolescence and early adulthood, when ovulatory cycles are fully established and PGF2α production is highest (Burnett & Lemyre, 2021). A contemporaneous study across five secondary schools in Douala documented a dysmenorrhoea prevalence of approximately 71% among adolescent girls aged 13–19 and identified lower socioeconomic status and school absenteeism as key correlates (Bih et al., 2025), lending regional corroboration to the present findings.

Fatigue in the menstrual phase is compounded by iron depletion from menstrual bleeding, which reduces haemoglobin and thus oxygen-carrying capacity, impairing aerobic exercise performance and general energy availability. This is an often-overlooked physiological mechanism linking the menstrual phase to exercise intolerance beyond pain alone. The 71.0% of participants reporting moderate functional impairment mirrors findings from Armour et al. (2021), who documented moderate-to-severe daily activity disruption in over 70% of a large Australian cohort, and aligns with Mboua et al. (2023), who reported functional disruption in over 70% of dysmenorrhoeic schoolgirls in Yaoundé.

5.2 Emotional Symptoms: Neurobiological Underpinnings

Sadness (70.0%) and mood swings (25.0%) as the dominant emotional symptoms reflect the complex neuroendocrine interplay of the late-luteal and early-menstrual phases. During the late luteal phase (days 22–28), the precipitous decline in oestradiol and progesterone reduces central serotonin synthesis and availability. Oestrogens normally upregulate serotonin transporter expression and increase tryptophan hydroxylase activity, the rate-limiting enzyme in serotonin biosynthesis; their withdrawal therefore reduces serotonergic tone. Concurrently, the rapid decline in progesterone which in its neuroactive metabolite form (allopregnanolone) exerts positive allosteric modulation of GABA-A receptors, producing anxiolytic and sedative

effects unmasks anxiety, irritability, and mood instability as GABAergic inhibitory tone is reduced (Hantsoo & Epperson, 2021; Benarroch et al., 2024). These combined serotonin-deficiency and GABA-withdrawal dynamics underlie the affective symptoms of PMS and explain why emotional symptoms are most pronounced during the late luteal and early menstrual phases (StatPearls: PMS, 2023). The finding that emotional changes moderately affected exercise participation in 69.0% of respondents including 10.0% who were greatly deterred is clinically important: impaired motivation, reduced reward sensitivity (via diminished dopaminergic tone), and fatigue from disturbed sleep collectively suppress the volitional drive to exercise precisely when its benefits would be greatest (Bruinvels et al., 2017; Armour et al., 2021).

5.3 Follicular Phase Preference: Hormonal Optimisation of Exercise

The strong preference for the follicular phase for exercise (71.0%) is congruent with its hormonal advantages. As oestradiol rises from the menstrual phase nadir to a pre-ovulatory peak of 200–400 pg/mL, it exerts multi-system anabolic and performance-enhancing effects. At the skeletal muscle level, oestrogen upregulates satellite cell activity and promotes muscle fibre repair after exercise-induced damage, thereby accelerating recovery and enabling higher training loads (Colenso-Semple et al., 2023; Kissow et al., 2022). Oestrogen also enhances glycolytic enzyme activity and insulin-mediated muscle glucose uptake, increasing substrate availability for high-intensity exercise. A meta-analysis of 22 studies (n = 433 women) confirmed a medium effect size (SMD = 0.60) for isometric maximal strength in the late follicular phase versus earlier phases (Hillebrecht et al., 2024). At the neuropsychological level, oestrogen upregulates serotonin synthesis, improving mood, motivation, cognitive clarity, and pain tolerance, creating the optimal performance window frequently reported by exercising women (Benarroch et al., 2024; Elorduy-Terrado et al., 2025). The present findings align precisely with these physiological predictions: participants who identified the follicular phase as their preferred exercise window were responding to genuine, hormonally driven improvements in energy, mood, and exercise capacity.

5.4 Exercise as a Non-Pharmacological Treatment for Menstrual Symptoms: Physiological Rationale

The finding that 70.0% of participants held positive beliefs about exercise during menstruation is encouraging and consistent with an extensive evidence base. Aerobic exercise stimulates the hypothalamus and anterior pituitary to release β-endorphins, which are endogenous opioid peptides that activate descending pain inhibitory pathways and suppress PGF2α-mediated uterine pain signals (Iacovides et al., 2015; Matthewman et al., 2022). An increase in circulating β-endorphin levels of 20–30% above resting values has been documented after moderate aerobic exercise, corresponding with clinically meaningful reductions in pain ratings (Daley, 2009). Exercise-induced systemic vasodilation increases uterine blood flow, reducing myometrial ischaemia; regular aerobic training may additionally suppress COX-2 activity over time, attenuating the prostaglandin cascade responsible for dysmenorrhoea (Matthewman et al., 2022). Furthermore, exercise acutely increases brain-derived neurotrophic factor (BDNF),

dopamine, and serotonin, providing neurobiological mechanisms for mood improvement and motivational enhancement during the luteal phase (Armour et al., 2021). These mechanisms justify the recommendation of moderate-intensity aerobic exercise as a first-line, non-pharmacological intervention for dysmenorrhoea, as endorsed by a systematic review and meta-analysis of 18 RCTs (Matthewman et al., 2022).

5.5 Cultural and Social Barriers: Implications

Despite predominantly positive individual perceptions, 42.0% of participants reported some form of cultural or social influence discouraging exercise during menstruation, including family discouragement (14.0%) and cultural restrictions (10.0%). These findings are consistent with the global literature on menstrual stigma: cultural taboos that portray menstruating women as impure, vulnerable, or inappropriately active reduce physical activity participation in ways that are physiologically harmful, depriving women of exercise's analgesic and mood-modulating benefits (Fennie et al., 2022; Frontiers in Reproductive Health, 2025). This finding underscores the necessity of community-level interventions that engage families, teachers, and community leaders alongside individual health education.

The dominance of rest combined with hydration as the primary coping strategy (58.0%) reflects an intuitive response; however, this strategy is inferior to light aerobic exercise, which provides active pain relief rather than passive symptom endurance. The finding that only 8.0% adopted light exercise and only 6.0% used pain medication suggests a knowledge gap regarding both pharmacological options (e.g., NSAIDs, which directly inhibit COX-2 and suppress PGF2α) and the evidence for light exercise as an effective, accessible self-management strategy (Iacovides et al., 2015; Matthewman et al., 2022).

6. CONCLUSION

Menstrual cycle phases significantly influence both symptom experience and exercise behaviour among female secondary school students and teachers in Douala, Cameroon. Dysmenorrhoea was the predominant physical symptom, driven by peak uterine PGF2α production during the menstrual phase, while sadness and mood swings reflected serotonergic and GABAergic dysregulation of the late luteal phase. The follicular phase was the strongly preferred window for exercise, consistent with its anabolic hormonal milieu of rising oestradiol. Despite positive individual perceptions of exercise, cultural and family-based discouragement remained barriers for a significant minority, and a knowledge gap regarding light aerobic exercise as an effective active coping strategy was identified. These findings underscore the urgent need for physiologically grounded, culturally sensitive menstrual health education in secondary schools in Cameroon.

7. RECOMMENDATIONS

Schools and policymakers should integrate physiologically accurate menstrual health education into secondary school curricula, incorporating cycle-phase-specific guidance on exercise as a non-pharmacological strategy for managing dysmenorrhoea and mood disturbances. Physical education policies should permit lighter activity during the menstrual

phase rather than full exemption, and school health staff should be trained to identify and appropriately refer students with severe dysmenorrhoea. Women of reproductive age are encouraged to track their menstrual cycles to optimise exercise timing prioritising high-intensity activity during the follicular and ovulatory phases and lighter, restorative activity during the menstrual and late luteal phases. Community-level interventions addressing cultural misconceptions about exercise during menstruation are equally essential to create enabling social environments. Future research should employ longitudinal designs with objective hormonal verification and expand to diverse urban and rural populations within Cameroon to improve the generalisability of these findings.

8. STRENGTHS AND LIMITATIONS

This study has several important strengths. It provides the first systematic characterisation of menstrual phase-specific symptom experience and exercise behaviour in a secondary school community in Douala, contributing locally relevant data to an underrepresented evidence base. The 100% response rate, dual-population design (students and teachers), and structured face-to-face data collection methodology ensure high internal validity and participant understanding.

Several limitations must be acknowledged. The cross-sectional design precludes causal inference; longitudinal data are required to establish temporal relationships between hormonal phases and observed behaviours. Menstrual cycle phase was self-reported without hormonal verification, introducing potential phase misclassification. The purposive sampling method limits random generalisability. Data on cycle length, oral contraceptive use, exercise intensity, and underlying gynaecological conditions were not captured, limiting interpretation. Social desirability and recall biases inherent to self-report data may also affect accuracy. Despite these limitations, this study provides a valuable and contextually relevant evidence base for menstrual health programming in Cameroonian schools.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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