

# Perceived knowledge of female athletes on the influence and effects of the menstrual cycle on musculoskeletal injuries

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## Abstract

**Background and Study Aim** The menstrual cycle (MC) has been theorized as a significant factor that contributes to musculoskeletal injuries amongst female athletes. However, the literature showing its effects are limited. Additionally, very little is known about the knowledge of the MC and its effects on the body and injury occurrence amongst competitive female athletes. The aim of the study was to investigate the knowledge levels on the effects of the MC and hormonal contraceptives amongst female athletes.

**Material and Methods** An online questionnaire was utilized. The questionnaire was distributed by the researchers, sports coaches and managers of the respective sports teams to university athletes older than 18 years. The data was analyzed quantitatively using the Statistical Package for the Social Sciences (SPSS, version 28).

**Results** A total of 76 participants were recruited in this study with a mean age of 21,12±2,033. Out of the 76 respondents, 50% had no knowledge and only 2,6% had very high knowledge of the MC and its effects on musculoskeletal injuries. Majority of the respondents had “low knowledge” (n=32) on the effects of hormonal contraceptives on the body and only 5 participants had “very high knowledge”.

**Conclusions** Majority of the female athletes' knowledge ranged from no to low knowledge of the MC and its effects on the body and musculoskeletal injuries. Additionally, the knowledge levels on the effects of hormonal contraceptives on the body were predominantly low. This highlights the importance of expanding the knowledge of female athletes and stakeholders within the sports community on the effects of the MC on injury occurrence.

**Keywords:** sport, women, menstruation, hormones, knowledge levels, musculoskeletal injuries

## Introduction

As female sports participation continues to grow, so does the athlete's susceptibility to injury [1]. The menstrual cycle (MC) has been theorized as a risk factor which leads to the occurrence of specific musculoskeletal injuries amongst female athletes [2]. The MC is defined as a biofeedback system which involves the development of an egg cell in the ovaries [3]. Cyclic changes occur in the female reproductive system to prepare for fertilization and pregnancy [4]. The length of the MC varies, lasting an average of 28 days [4]. The MC consists of three phases and the onset is the follicular phase occurring from day 1 to 9 with estrogen being the predominant hormone [5]. The following phase is the ovulation phase which occurs from day 10 to 15 whereby estrogen reaches its peak levels in the MC [5]. The final phase, the luteal phase, lasts from day 15 to 28 and during this phase progesterone levels are at their peak, and they surpass estrogen levels [6]. An additional hormone produced during the follicular and luteal phase is relaxin, while testosterone fluctuates throughout the MC and aids in the production of estrogen [6].

The three main hormones which have been studied include estrogen, progesterone and relaxin [7]. The series of hormonal changes that take place during the MC have been considered to influence injury risk [7]. Previous studies have demonstrated the effects of the MC on muscle and ligament laxity, tissue temperature and muscle-tendon stiffness [2], in which numerous have discovered a significant association between the MC and anterior cruciate ligament (ACL) injuries in the knee [5, 7, 8]. Oral hormonal contraceptives have synthetic progesterone as the active hormone and they affect the regular menstrual cycle through preventing ovulation, by repressing the development and rupture of the follicle [9]. The suppressed follicular development results in decreased estrogen levels [9]. It is theorized that decreased estrogen levels may be associated with strengthened ligaments including the ACL and soft tissue. The use of oral contraceptives is suggested to decrease the occurrence of traumatic injuries and leads to the prevention of decreased premenstrual fitness [9]. Additionally, the athletes on oral contraceptives disclosed to have experienced better stability however the effects of hormonal contraceptives use are not monitored and prioritized amongst female athletes [9, 10].

Although previous literature highlights the MC as a potential risk factor for injury, there have been limited studies that demonstrate the knowledge of the MC on injury risk amongst female athletes and sports coaches [11]. Knowledge related to athletic injuries sustained in the sports industry historically focused on male athletes, which stemmed from the fact that males were dominating sports participation in comparison to females [6]. Seventy-four percent of female athletes had limited to no knowledge of the MC and majority of the athletes considered their coaches to have limited knowledge of the increased risk of the MC on sports performance [11]. As a result, the existing literature and research is insufficient for athletes and sports coaches, and knowledge on this topic is needed for training modification during the MC. Considering the lack of research on the topic, the aim of this study was to determine the knowledge of the effects and influence of the MC and hormonal contraceptives on musculoskeletal injuries amongst female athletes.

## Materials and Methods

### *Participants*

Female athletes aged 18 years and older competing at different competitive levels from different sporting codes at an urban, public university were recruited to participate in the study. Inclusion criteria for participation in the study were female athletes who are above the age of 18 years, training for three or more days per week and have started their MC. Prior to data collection for the study, ethical approval was obtained from the institution's Research Ethics Committee.

### *Research Design*

A quantitative, descriptive research design was utilized.

### *Procedure*

The data was captured on a self-reported basis by means of an online questionnaire formulated on the Google Forms platform. All participants received a link to the information letter and informed consent before participating in the study. If consent was not provided, the participant was not given access to the questionnaire and was directed to the end of the questionnaire. The questionnaire was anonymous, although it requested demographic information, such as age, sports involvement and training frequency (days per week). It included multiple choice questions (ranging from two to twelve possible options based on the question) and a short answer question regarding the participant's history of the MC. Questions included the occurrence and consistency of their cycle, the duration of the cycle, menstrual symptoms and hormonal contraceptive use. In addition, certain questions assessed the participants' knowledge of the MC and hormonal

contraceptives and its effects on injury risk on the musculoskeletal system. These questions had four or five possible answers, which ranged from "no knowledge" to "very high knowledge". Question twenty-one enquired about the extent to which the participant can ask their sports coaches questions related to the MC and its impacts on the body.

### *Validity and reliability of the Questionnaire*

Following the formulation of the questionnaire, a pilot study was conducted. Six female athletes, who met the inclusion criteria of the study, were asked to complete the questionnaire and provide comprehensive feedback to the researchers regarding their understanding of the questions included. The pilot study participants were between the ages of 20 and 24 years and competed in various sports. These sports included athletics, soccer, netball and rowing. Following the completion of the pilot study, changes were made to the questionnaire based off the feedback provided. The changes recommended the inclusion of the words 'sports specific injuries' in the information letter to allow a better understanding of the type of injuries the research was looking at, adding additional answers to the questions to allow more specific answers to the questions, making some questions multiple response such as the questions enquiring about symptoms and sport participation. Additionally, feedback was given about the amount of time it took to complete the questionnaire, in which one participant felt that 10 to 15 minutes was misleading and thus was reduced to 5 to 10 minutes.

### *Statistical analysis*

Data was analysed quantitatively using the Statistical Package for the Social Sciences (SPSS, version 28). Descriptive (means and standard deviations, frequencies and percentages) and inferential statistics (t-tests) were computed and a confidence interval of 95% with a statistical significance of  $p < 0.05$  was used.

## Results

### *Demographics*

A total of 76 females participated in the study, with the demographic results regarding their age, sporting codes and training frequency demonstrated in Table 1 and Table 2. The mean age of the participants was  $21,12 \pm 2,033$  with the minimum age being 19 and 27 being the maximum age. Thirty-six of the participants were netball players (40%), while 23 participated in athletics (25.6%) and 9 were rugby players (10%). Majority of the participants (71.1%) trained 3 to 4 days per week.

### *Knowledge of the MC*

Majority of the respondents (99%) reported that they know what the MC is while 1% reported having no knowledge of the MC, as shown in Figure 1. The results, as seen in Figure 2, indicate that 40

**Table 1.** Age-related statistics

Category	Mean±SD	Minimum	Maximum
Age	21,12±2,033	19	27

**Table 2.** Demographic results of the sporting codes and training frequencies

Category	Frequency	Percent (%)
<b>Sport Code</b>		
- Athletics	23	25.6
- Basketball	6	6.7
- Rugby	9	10
- Soccer	4	4.4
- Hockey	5	5.6
- Netball	36	40
- Cheerleading	7	7.8
- Gym	2	2.6
- Rowing	1	1.3
- Squash	1	1.3
- Other	3	3.9
<b>Training frequency</b>		
- 3-4 days/week	54	71
- 5-6 days/week	17	22.4
- 6-7 days/week	5	6.6

of the participants (52.6%) reported to have “some knowledge” while only 14 participants (18.4%) reported to have “very high knowledge” on the effects that the MC and female hormones have on the body. The data in Figure 3 shows that 38 of the participants (50%) have “no knowledge” on the effects that the MC has on injury occurrence while 8 participants (10.5%) reported to have “some knowledge” and only 2 participants (2.6%) reported to have “very high knowledge”.



**Figure 1.** Knowledge of the MC

#### *Knowledge of Hormonal contraceptives*

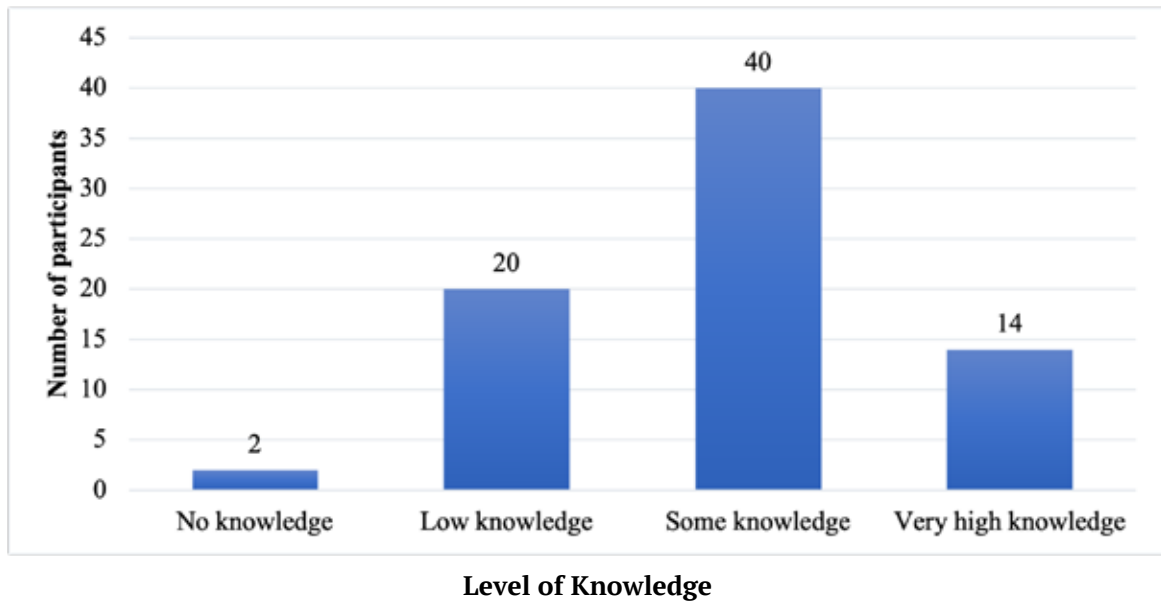
The participants were asked to indicate whether they were currently using hormonal contraceptives, in which 57 participants (75.0%) answered “yes” and only 25.0% answered “no”. In addition to this, the participants were then asked to rate their knowledge of the effects of hormonal contraceptives on the body, on a scale from “no knowledge” to “very high knowledge”, of which the results can be found in Figure 4. According to the results, majority of the respondents had “low knowledge” (n=32) on the effects of hormonal contraceptives on the body, 22 had “some knowledge”, 17 had “no knowledge” and only 5 participants had “very high knowledge”.

#### **Discussion**

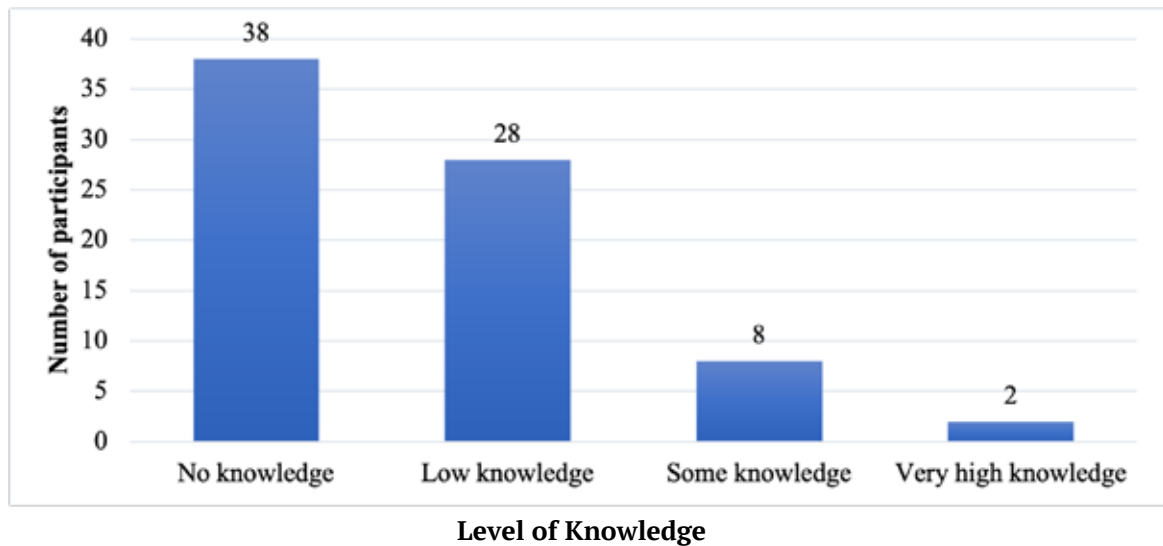
The aim of this study was to determine the knowledge of the effects of the MC and hormonal contraceptives on musculoskeletal injuries amongst female athletes competing in various sporting codes at the university.

#### *Demographics*

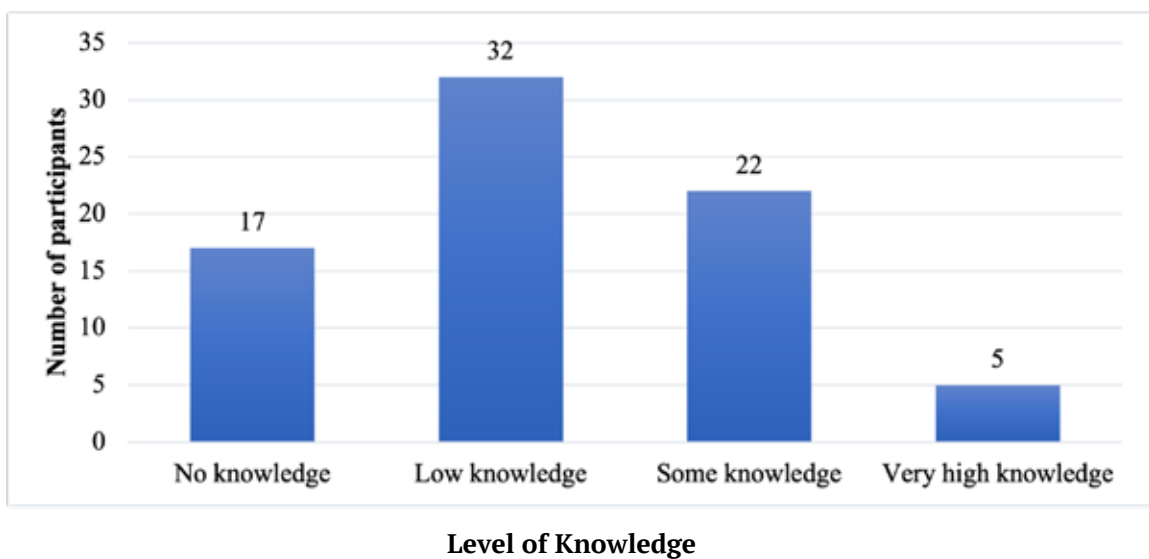
Research shows that netball is a commonly played sport among female athletes [12]. In this



**Figure 2.** Knowledge levels on the effects of the MC & female hormones on the body



**Figure 3.** Knowledge levels on the effects of the MC on injury occurrence



**Figure 4.** Knowledge of hormonal contraceptives in musculoskeletal injuries

study, the highest selected sporting code was netball with 40% of the participants being netball players. Prolonged and high intensity exercise has been indicated to have unfavourable effects on the female reproductive hormones which result in disturbances in the MC [13]. Seventy-one percent of the respondents indicated that they train 3 to 4 days per week and 22.4% indicated that they train 5 to 6 days per week. These findings suggest that due to their frequent training sessions, the prolonged exercise the athletes partake in may result in the participants being at risk of experiencing adverse effects with their MC and experience hormonal disturbances [13].

#### *Knowledge of the MC*

When the participants were asked about their knowledge levels on the effects of the female hormones and the MC on the body, 52.6% indicated that they have “some knowledge” while 18.4% reported to have “very high knowledge” regarding the topic. Additionally, 50% of the participants reported that they have “no knowledge” on the effects the MC has on injury occurrence. One of the prevalent findings resulting in exercise-induced menstrual disturbances is a dysfunction in the production of gonadotrophins [13]. The purpose of the gonadotrophin-releasing hormone is to signal the brain to allow the pituitary gland to secrete follicle-stimulating hormone (FSH) and luteinizing hormone (LH) which are integral hormones in the production of estrogen and progesterone [7]. It has been theorized that the disparity between energy intake and energy expenditure plays a big role in the availability of energy during exercise [14]. This results in a defect in the hypothalamus, affecting the production of gonadotrophins and ultimately resulting in menstrual dysfunctions [13]. Studies have only expanded on the pathophysiological reasoning behind the exercise-induced menstrual disturbances however there are no studies assessing the female athlete’s knowledge levels on the effects the MC and female hormones have on the body and injury occurrence.

#### *Knowledge of hormonal contraceptives*

As shown in the results of this study, the use of hormonal contraceptives was common amongst the participants (75.0%). These results support the findings in a study which reported that approximately 50% of British elite athletes and 47% of Australian athletes use hormonal contraceptives [2,15]. Hormonal contraceptives are commonly used to prevent pregnancy, to control the MC and to potentially reduce MC-related symptoms amongst competitive female athletes [10]. However, the effects of hormonal contraceptives on sports performance and injury occurrence are often omitted in previous literature. It has been postulated that injury to the ACL is reduced by 20% [9]. This is believed to be

due to the depression of estrogen by progestines (compounds found in oral contraceptives), which lead to a decreased risk of ligament laxity and soft tissue weakness [9]. However, it is important to note that this may not be the case for all ligaments in the body. A link between increased inversion-eversion laxity in the ankle and consistency of hormonal fluctuations caused by oral contraceptives was not discovered, suggesting that ankle ligaments respond differently to knee ligaments, such as the ACL [16]. Therefore, additional studies on the effects of hormonal contraceptives on other anatomical structures would be exceedingly valuable.

As mentioned, the use of hormonal contraceptives amongst athletes can result in negative effects on sports performance and injury occurrence, therefore knowledge about this subject is necessary within the athletic and sports community. This study investigated the knowledge levels of the effects of the hormonal contraceptives on the body amongst female athletes. As indicated, the results displayed interesting variances in the knowledge of hormonal contraceptives on the body, with majority of the respondents reporting the use of hormonal contraceptives, but also indicating that they have “low knowledge” and less participants stating “very high knowledge” on the effects of hormonal contraceptives on injury occurrence. These findings support the evidence contributed by a study which discovered that approximately 25% of the participants in the study felt adequately knowledgeable on the effects of hormonal contraceptives on training performance [17]. It is important to note that previous literature primarily focused on the perceived effects of hormonal contraceptives on sports performance, rather than the knowledge of this effect on injury occurrence [2,12]. This, therefore, makes it difficult to draw conclusions on the level of knowledge athletes possess on injury risk and occurrence.

### **Conclusions**

This study aimed to determine knowledge levels on the effects and influence of the MC on musculoskeletal injuries amongst female athletes. This was successfully completed by assessing their knowledge on the MC and effects on injury occurrence as well as assessing their knowledge on female hormones and hormonal contraceptives. The key findings from the study concluded that majority of the female athletes’ knowledge levels ranged from no knowledge to low knowledge with regards to the effect the MC and female hormones have on injury occurrence and their effect on the body. Going forward, this study can help broaden the knowledge of female athletes, the Biokinetics field and sports industry on the effects of the MC on injury occurrence and functionality of the female body. This will challenge sports coaches



and Biokineticists to find ways to factor in the MC with regards to training and rehabilitation and finding methods to reduce the injury occurrence. This study brings light to the gaps in relation to the lack of studies explaining the pathophysiological reasons behind female orientated sports-related musculoskeletal injuries showing that there is still limited focus on literature focused on understanding the functionality of the female body.

### Highlights

The limitations in this study include limited responses to the questionnaire which resulted in a small sample size as well as reduced comparisons and correlations being made with the findings from the study. This was due to the questionnaire being distributed online as some participants experienced challenges, such as not having a device with them or not having access to internet connection to

complete the questionnaire. Recommendations for future research include having a larger sample size with equal groups would be beneficial for more correlations to be drawn from the findings. Having an equal amount of participants for each sporting code will aid in an equal comparison among the participants.

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### Conflicts of interest

The authors declare no conflicts of interest.

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