



# The Impact of Menstrual Hygiene Products on Physical Fitness, Comfort, and Hygiene Practices among Female Athletes in Sri Lanka

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## Abstract:

**Background:** Female athletes require proper menstrual hygiene management to maintain comfort, hygiene, and performance during physical activity. Products such as sanitary pads (SP), tampons (T), menstrual cups (MC) and others are commonly used, with selection influenced by various factors. This study examined the impact of menstrual hygiene products on physical fitness (PF), comfort (C), and hygiene practices (HP) among female athletes in Sri Lanka.

**Methods:** Forty female athletes ( $n = 40$ ), mean age ( $23.33 \pm 3.38$ ) years, were selected through purposive sampling from Volleyball (06), Gymnastics (03), Swimming (08) and Athletics (23). C and HP data were collected through a Structured Questionnaire and PF was assessed through the 30m sprint (30m S), vertical jump (VJ), Agility T-test (ATT) and the 12-minute Cooper test (12C). Non – parametric Kruskal – Wallis tests (SPSS version 21;  $p = 0.05$ ) were applied due to non – normal data distribution.

**Result:** Results indicated a statistically significant difference in the ATT score ( $p = 0.045$ ), indicating variations in agility performance among product users. No significant differences were found in the results of the 30m S ( $p = 0.158$ ), VJ ( $p = 0.735$ ), or 12C ( $p = 0.763$ ). Comfort levels were significantly higher among MC users ( $p = 0.003$ ). Moreover, there were significant differences in HP, with MC users reporting better practices ( $p = 0.012$ ).

**Conclusion:** Finally, athletes using T and MC reported higher satisfaction than those using SP, with a significant preference for these products. MC and T were associated with higher comfort levels, better HP and improved physical performance, while pads were found to limit comfort and mobility, particularly during sports activities.

**Keywords:** Biomechanical Analysis, Electromyography, Explosive Strength, Muscle Activity, Vertical Jump

## 1. INTRODUCTION

Menstrual health is a fundamental yet often overlooked component of overall well-being among female athletes. With the rapid growth of women's participation in competitive and recreational sports worldwide, attention has increasingly shifted toward understanding the unique physiological and practical challenges faced by female athletes. While performance outcomes are typically associated with physical fitness, endurance, and strength, menstrual health

can influence each of these domains. Hormonal fluctuations across the menstrual cycle affect metabolism, hydration, thermoregulation, and neuromuscular function, thereby shaping training capacity, recovery, and competition performance (McNulty et al., 2020). Consequently, effective menstrual health management has become an essential element of athlete care and performance optimization.

Physiological changes during the menstrual cycle may alter an athlete's readiness and response to exercise. The luteal phase, characterized by elevated progesterone levels, has been linked with increased fatigue, higher perceived exertion, and reduced endurance, whereas the follicular phase is often associated with favorable strength and power outcomes due to relatively higher estrogen levels (Bruinvels et al., 2016). These variations are particularly important for athletes engaged in high-intensity and endurance sports where thermal regulation, hydration, and energy availability are critical. Additionally, menstrual symptoms such as dysmenorrhea, bloating, headaches, and mood

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disturbances may compromise training consistency and competitive performance. Previous studies indicate that many female athletes modify training load or competition participation due to menstrual discomfort, highlighting menstruation as both a physiological and psychological factor in sport performance.

Beyond physiological effects, the management of menstruation in sport environments presents practical challenges. Comfort, mobility, confidence, and hygiene are closely linked to the type of menstrual hygiene products used during training and competition. Sanitary pads, though widely used, may restrict movement, cause chafing, and increase anxiety related to leakage during high-impact activities. In contrast, tampons and menstrual cups offer greater freedom of movement, improved protection, and longer wear time, making them more suitable for athletic participation (Prendergast et al., 2019; Gerritsen et al., 2021). However, the adoption of these products remains limited due to factors such as cultural stigma, lack of awareness, fear of discomfort, and limited access, particularly in low- and middle-income countries.

Access to appropriate menstrual hygiene products and facilities is a persistent concern in many sporting contexts. In settings where menstruation is viewed as a private or taboo topic, athletes may hesitate to seek guidance from coaches or medical staff. This silence can result in poor hygiene practices, inadequate product choices, and increased vulnerability to infections and discomfort (Chandra-Mouli & Patel, 2017). In Sri Lanka, where female participation in sport is steadily increasing, limited empirical evidence exists regarding how female athletes manage menstruation during training and competition, what products they rely on, and how these choices influence performance, comfort, and hygiene behaviors.

Despite growing international research on menstrual health in sport, there is a notable lack of context-specific studies focusing on South Asian female athletes. Cultural norms, economic constraints, and infrastructure differences may shape menstrual hygiene practices differently from those observed in high-income countries. Understanding these contextual factors is crucial for designing athlete-centered policies, education programs, and support systems. Therefore, this study aims to examine the impact of menstrual hygiene products on physical fitness, comfort, and

hygiene practices among female athletes in Sri Lanka. By identifying product usage patterns, perceived performance effects, and hygiene challenges, this research seeks to contribute evidence that can support healthier, more inclusive, and performance-oriented sporting environments for Sri Lankan women.

## 2. MATERIAL AND METHOD

### 2.1 Research Design

The study employed a cross-sectional research design with elements of short-term observational assessment to examine the relationship between menstrual hygiene product usage and athletic performance, comfort, and hygiene practices. A quantitative research approach was adopted, integrating objective physical fitness tests and a structured questionnaire. This design enabled the collection of performance-based measurements alongside self-reported data on comfort and hygiene behaviors during menstruation.

### 2.2 Study Area

The study was conducted among female athletes in Sri Lanka who are actively involved in competitive and amateur sports. Participants were recruited from multiple sports institutions and training centers to ensure adequate representation. Athletes from disciplines such as athletics, swimming, gymnastics, and volleyball were included to capture variation across different physical and technical sport demands.

### 2.3 Population and Sample

The study population consisted of female athletes aged 18–35 years. A total sample of 30 athletes representing four sports categories was selected for participation. The distribution of the sample was Volleyball – 06, Swimming – 08, Gymnastics – 03, Athletics – 23. Participants were required to be actively training and to experience regular menstrual cycles to be eligible for inclusion.

### 2.4 Sampling Technique

A purposive sampling technique was used to recruit athletes who met the inclusion criteria. This approach ensured that only female athletes with relevant training exposure and menstrual experience were selected. Representation from different sport disciplines was maintained to enhance the generalizability of findings within the athletic population.

### 2.5 Data Collection Procedures

Data collection consisted of two components : physical fitness testing and a structured questionnaire.

#### 2.5.1 Physical Fitness Tests

Four standardized tests were administered to assess key components of physical fitness ;

##### 1. 30 m Sprint Test

Participants performed a maximal sprint over a distance of 30 meters. Athletes began from a stationary position with one foot placed forward behind the starting line and held the position for two seconds before starting. No rocking movements were allowed. Time was recorded using a stopwatch, and participants were encouraged to sprint maximally through the finish line (Thotawaththa & Chandana, 2023).

##### 2. Vertical Jump Test

Athletes stood side-on to a wall and marked their standing reach height with the nearest hand. From

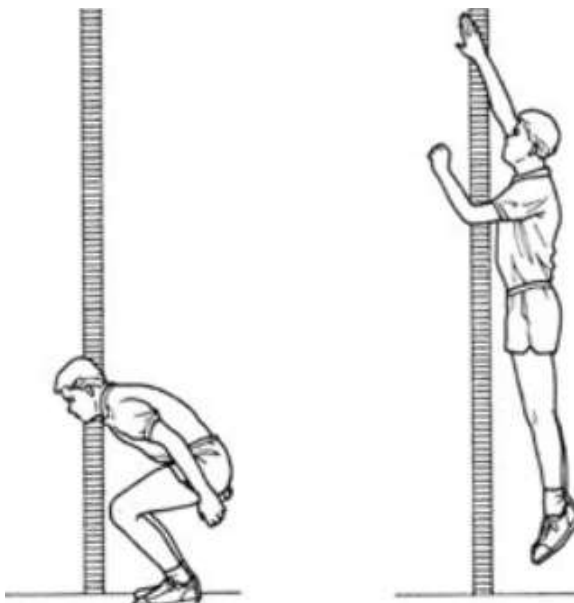


Figure 1. Diagram of Vertical jump test

a standing position, participants jumped vertically as high as possible using both arms and legs (figure 1). The difference between standing reach and jump height was recorded as the score. Three trials were given, and the best performance was recorded in centimeters (Gamlath & Thotawaththa, 2023; Thotawaththa et al., 2023; Thotawaththa & Chandana, 2023).

##### 3. Agility T-Test

Participants started at cone A, sprinted forward to cone B and touched the base with the right hand,

shuffled left to cone C touching with the left hand, shuffled right to cone D touching with the right hand, shuffled back to cone B touching with the left hand, and then back-pedaled to cone A (figure 2). Time was recorded when the participant crossed cone A (Gamlath & Thotawaththa, 2023).

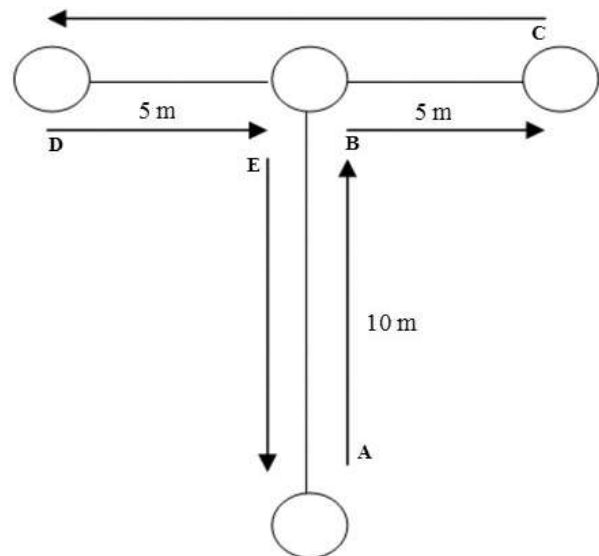


Figure 2. Diagram of T-Test (Direction - A, B, C, D, E and A)

##### 4. 12-Minute Cooper Test

Markers were placed around the running track to assist distance measurement. Participants ran continuously for 12 minutes, and the total distance covered was recorded in meters. Walking was permitted, but athletes were encouraged to maximize distance (Martinez-Lemos et al., 2024).

#### 2.5.2 Questionnaire

A structured questionnaire was administered to collect data on : Demographic information, Menstrual hygiene product usage, Comfort level during sports participation, Hygiene practices during menstruation, Feedback and suggestions. Responses were measured using categorical and Likert-scale items.

### 2.6 Data Analysis

Quantitative data were analyzed using the Statistical Package for the Social Sciences (SPSS version 21). The following statistical techniques were applied: Descriptive statistics (mean, standard deviation, frequencies, and percentages) to summarize demographic characteristics and product usage patterns. Non-parametric tests, specifically the Kruskal–Wallis test, to compare comfort and hygiene practices across different

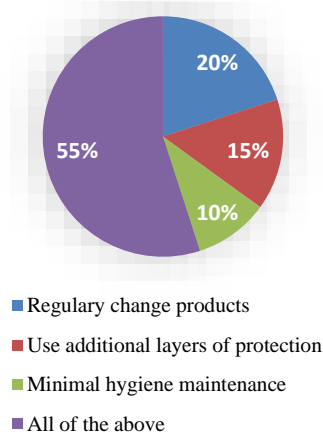
menstrual hygiene product groups. Statistical significance was set at  $p < 0.05$ .

### 3. RESULT AND DISCUSSION

#### 3.1 Descriptive Statistics

##### 3.1.1 Hygiene management during sports events

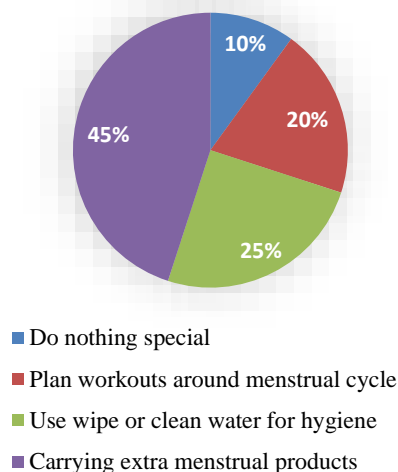
To investigate the hygiene practices of female athletes during menstruation, participants were asked how they manage hygiene while using menstrual products during sports events. The results are presented in the figure below:



**Figure 3.** Hygiene management during sports events

The findings indicated that 55 % of female athletes followed comprehensive hygiene practices during menstruation, such as regularly changing products, using additional protective layers, and maintaining personal cleanliness. This proactive behavior highlights a promising level of awareness among athletes. However, 10 % reported only minimal hygiene maintenance, which raises concern for potential health risks during physical activity (figure 3). These findings correspond with [Srivastava \(2024\)](#), who found that hygiene practices are often limited by facility constraints and lack of awareness, especially among athletes in developing countries. Similarly, [Aziz et al. \(2022\)](#) noted that poor menstrual hygiene can lead to discomfort, infections, and reduced sports participation, particularly in lightweight athletes due to physiological vulnerabilities. While the majority demonstrate good hygiene behavior, targeted interventions are needed to support the minority who lack adequate practices potentially due to stigma, limited education, or lack of access to appropriate resources.

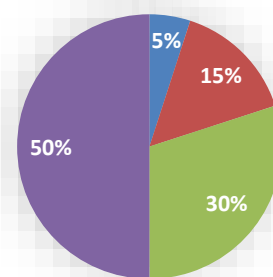
##### 3.1.2 Maintain hygiene while using menstrual hygiene products during sports



**Figure 4.** Maintain hygiene while using menstrual hygiene products during sports

According to figure 4, in terms of how hygiene was maintained, 45 % of participants reported carrying extra menstrual products, 25 % used clean water or wipes, and 20 % planned workouts around their menstrual cycle. Only 10 % reported doing nothing special. The adaptation strategies observed here show a balance between preparedness and behavioral management. Carrying extra products indicates a high level of individual responsibility, aligning with [Przybylo \(2020\)](#) who suggested that menstrual management is strongly influenced by knowledge and planning. On the other hand, the 10 % who do not adopt any hygiene strategy are potentially at risk of infections or discomfort, highlighting the need for education, as emphasized by [McGawley et al. \(2023\)](#). While most athletes show good hygiene habits, a small group may benefit from further guidance and support systems to manage menstruation hygienically in sports contexts.

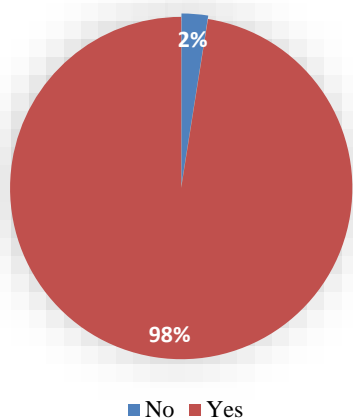
##### 3.1.3 Carrying additional hygiene products



**Figure 5.** Carrying additional hygiene products

Responses revealed that 50 % of athletes always carry hygiene products, 30 % sometimes, 15 % rarely, and 5 % never. This finding suggests a relatively strong culture of preparation among athletes. However, the 20 % who rarely or never carry extra products may face issues in cases of unexpected menstrual flow, leading to discomfort and poor hygiene (figure 5). This finding aligns with Bali et al. (2024), who highlighted that lack of access or poor awareness regarding menstruation often results in hygiene neglect and reduced participation in sports. Consistent preparation is key to menstrual hygiene. Campaigns promoting menstrual product readiness and availability can fill the gap among less-prepared athletes.

### 3.1.4 More menstrual-friendly facilities

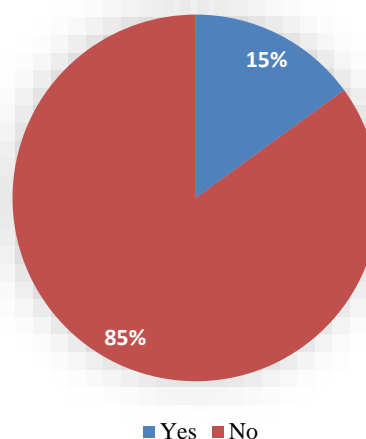


**Figure 6.** More menstrual-friendly facilities

A significant 97.5 % of respondents supported the need for more menstrual-friendly facilities in sports environments, such as private changing areas, proper disposal systems, and access to clean water (figure 6). This overwhelming response echoes the findings of Sommer et al. (2017) and Brown et al., (2021), who stressed that lack of adequate WASH (Water, Sanitation, and Hygiene) infrastructure severely limits menstrual hygiene management in sports, schools, and public settings. There is a strong demand for infrastructure development to support menstrual health in athletics. Addressing this need would improve athlete well-being and

reduce dropout rates linked to menstruation-related discomfort.

### 3.1.5 Participation in awareness programs



**Figure 7.** Participation in awareness programs

According figure 7 Only 15 % of participants had attended menstrual health awareness programs, while 85 % had not. This finding signals a serious gap in menstrual education within athletic and academic environments. These statistics are consistent with McGawley et al. (2023), who found that athletes, coaches, and practitioners had low levels of menstrual health literacy and a lack of formal discussion forums. Moreover, Haider and Phamaceticals (2023) discussed how cultural silence and lack of open conversation contribute to this educational gap. There is an urgent need to integrate menstrual health education into athletic training and school curricula, breaking stigma and fostering informed hygiene practices.

### 3.2 Physical Fitness Scores

To investigate the impact of menstrual hygiene products (pads, tampons, and menstrual cups) on physical fitness, comfort, and hygiene practices among female athletes. Since the data were not normally distributed, the Kruskal-Wallis H test was employed to compare the differences across the three groups. A significance level of  $p < 0.05$  was used.

**Table 1.** Kruskal-Wallis Results for Physical Fitness Variables

Variable	Chi-Square	p-value	Significant	Highest Mean Rank
30m (During)	3.687	0.158	No	Tampon (25.06)
Vertical Jump (During)	0.617	0.735	No	Pad (21.59)
T test (During)	6.207	0.045*	Yes	Tampon (26.19)
12 Min Cooper Test (During)	0.541	0.763	No	Pad (21.74)

The Kruskal-Wallis analysis indicated a statistically significant difference in agility performance among the three groups ( $p = 0.045$ ), with tampon users achieving the highest mean rank (table 1). This aligns with findings from [Hennegan et al., \(2020\)](#) and [Prendergast et al. \(2019\)](#), who noted that tampons offer superior mobility due to their internal placement, which minimizes external friction and discomfort. Although not statistically significant, trends from this study showed that tampon and cup users performed slightly better in sprint and agility tests, while pad users showed marginally higher scores in endurance and vertical jump tests. This echoes the work of [Nozari et al. \(2019\)](#), who observed that pads may impair

performance due to discomfort, chafing, and bulkiness during intense activity. Furthermore, the paired t-test analysis revealed performance declines in all fitness components during menstruation, especially in aerobic endurance. This supports [Read et al. \(2022\)](#), who found that 100% of athletes in their study reported performance deterioration during the menstrual phase. Similarly, [Meignié et al. \(2021\)](#) and [Van Eijk et al., \(2016\)](#) found that endurance, joint laxity, and metabolic efficiency could be negatively affected by hormonal fluctuations during menstruation.

### 3.2.1 Comfort Scores

**Table 2.** Kruskal-Wallis Results for Comfort Variables

Variable	Chi-Square	p-value	Significant	Highest Mean Rank
Comfort 1	5.488	0.064	No	Tampon (24.94)
Comfort 2	3.865	0.145	No	Tampon (25.00)
Comfort 3	5.776	0.056	No	Tampon (27.50)
Comfort 4	3.124	0.210	No	Cup (24.72)

While no comfort variable reached statistical significance, tampon users consistently reported higher comfort levels, with borderline significance in comfort 1 and comfort 3 ( $p = 0.064$  and  $0.056$  respectively). Cup users also reported relatively

higher comfort. Pad users scored the lowest across most comfort indicators, indicating potential discomfort during sport (table 2).

### 3.2.2 Hygiene Practices

**Table 3.** Kruskal-Wallis Results for Hygiene Practice Variables

Variable	Chi-Square	p-value	Significant	Highest Mean Rank
Hygiene 1	1.571	0.456	No	Cup (24.28)
Hygiene 2	12.085	0.002*	Yes	Tampon (30.75)
Hygiene 3	9.544	0.008*	Yes	Tampon (29.75)

Significant differences were observed in hygiene practices Hygiene 2 and Hygiene 3, with tampon users showing significantly better hygiene behaviors ( $p = 0.002$  and  $0.008$  respectively). These results suggest tampons may be more conducive to maintaining proper hygiene during sports activities. Cups also performed relatively well, while pad users ranked lowest (table 3).

The analysis shows that the type of menstrual hygiene product has a measurable effect on certain aspects of athletic performance, comfort, and hygiene practices. Agility performance was significantly better among tampon users, which may be due to less bulk and improved movement freedom. Comfort levels, although not statistically significant, were consistently higher in tampon and menstrual cup users. Hygiene

practices showed statistically significant improvement in tampon users, highlighting their effectiveness in managing menstruation during sport with better practices such as timely changing and cleanliness. These findings are aligned with previous literature that internal menstrual products (tampons, cups) are more compatible with active lifestyles ([Przybylo and Fahs, 2020](#)). The limitations faced by pad users may stem from design constraints such as friction, limited absorption, and discomfort during high-intensity movement. The Kruskal Wallis results underscore the importance of menstrual product choice in optimizing performance, comfort, and hygiene for female athletes. The findings advocate for the promotion of awareness and access to a broader range of menstrual hygiene products, especially in athletic

settings, to support female athletes' wellbeing and performance.

Overall, the findings of this research reinforce the significance of menstrual product choice on athletic experience. Tampons and menstrual cups were associated with better comfort, hygiene, and agility performance. While physical fitness was not statistically correlated with product type, qualitative trends suggest that internal products support more effective participation in sport.

These insights highlight the importance of menstrual education, access to a variety of products, and supportive infrastructure in sports environments. Aligning with global literature, this study emphasizes the necessity for menstrual-friendly sports policies to ensure female athletes can perform comfortably and hygienically.

### 3.2.3 Physical fitness during menstruation and before menstruation

**Table 4.** Descriptive Statistics before and during

Test	Mean (Before)	Mean (During)	Std. Deviation (During)	Std. Error
30m Sprint (sec)	5.26	5.41	1.105	0.175
Vertical Jump (cm)	29.88	28.85	4.933	0.780
Agility T test (sec)	14.24	14.52	1.674	0.265
12 min Cooper test (m)	1746.25	1625	305.295	48.271

The results of this study indicate a noticeable decline in physical performance among female athletes during their menstrual period compared to the pre-menstrual phase. When analyzing the results of the selected physical fitness tests 30m sprint, vertical jump, agility T-test, and 12-minute Cooper test a consistent pattern emerges, demonstrating that performance tends to be better before menstruation (table 4). In the 30m sprint test, the mean time before menstruation was 5.26 seconds, while it increased to 5.41 seconds during menstruation. Since sprint performance is evaluated based on how quickly the distance is covered, a lower time indicates better performance. The increase in sprint time during menstruation suggests a slight decline in explosive speed, possibly due to physical discomfort, fatigue, or hormonal fluctuations affecting muscle contraction efficiency.

Similarly, in the vertical jump test, which assesses lower body power, the mean jump height decreased from 29.88 cm before menstruation to 28.85 cm during menstruation. This reduction reflects diminished explosive leg strength and power, which may be influenced by factors such as cramps, reduced energy levels, and decreased neuromuscular coordination during menstruation. The agility T-test, which evaluates an athlete's ability to change direction quickly, also showed reduced performance during menstruation. The mean time before menstruation was 14.24 seconds, compared to 14.52 seconds during menstruation. Agility is a

crucial component in many sports, and the increased time required to complete the test during menstruation indicates a decline in agility and responsiveness, which could be associated with fatigue, discomfort, and reduced focus during this phase.

In the 12-minute Cooper test, which measures cardiovascular endurance, the distance covered before menstruation was significantly higher (mean = 1746.25 meters) than during menstruation (mean = 1625 meters). This substantial decrease suggests that aerobic capacity and endurance levels are negatively affected during the menstrual phase. This could be attributed to lower hemoglobin levels, hormonal changes (such as increased prostaglandins), and physical discomfort, all of which can impair oxygen transport and energy production. Overall, the findings clearly show that performance in speed, power, agility, and endurance-based tasks tend to decline during the menstrual period. These changes may be the result of a combination of physiological, hormonal, and psychological factors. It is important to consider individual variability, as some athletes.

### 3.3 Correlation Analysis

The study findings on the impact of menstrual hygiene products on female athletes, using Pearson correlation analysis to explore one-to-one relationships between menstrual product usage,

comfort, hygiene practices, and physical fitness. The aim is to identify which factors are significantly related and to provide practical insights based on those relationships.

The results show a moderate, statistically significant positive correlation between menstrual product type and comfort level ( $r = 0.387$ ,  $p = 0.003$ ). This means that athletes who used tampons or menstrual cups tended to report higher comfort during physical activity than those who used pads. This finding aligns with multiple studies in the literature. [Ahuja and Singh \(2022\)](#) emphasized that menstrual cups are a cost-effective and sustainable alternative offering better comfort during physical exertion. Similarly, [Sommer et al. \(2017\)](#) and [Prendergast et al. \(2019\)](#) observed that internal menstrual products (cups and tampons) enhanced athlete confidence and reduced movement restriction, thereby improving overall comfort levels during sport. In contrast, [Hennegan et al., \(2020\)](#) identified discomfort, chafing, and restricted mobility as common issues faced by pad users, especially during intense movement. Internal products (cups, tampons) offer superior comfort during sports activity. Promotion of these alternatives, alongside proper education, may enhance athletic participation and reduce discomfort-related dropouts.

A significant positive correlation was found between menstrual product type and hygiene practices ( $r = 0.328$ ,  $p = 0.012$ ). This suggests that athletes using tampons and menstrual cups are more likely to engage in effective menstrual hygiene practices. The likely reasons include the sterilization and proper usage techniques associated with cups and tampons. These products require more deliberate maintenance, which cultivates better hygiene awareness. As found in [Sumpter and Srivastava et al., \(2024\)](#), hygiene was compromised when products were not changed frequently, or facilities were inadequate. Similarly, [Brown et al., \(2021\)](#) highlighted that internal product users often had better education and awareness of menstrual health, translating into healthier hygiene behavior. Moreover, [Rahaman \(2019\)](#) and [Aziz et al. \(2024\)](#) suggested that menstrual product choice impacts hygiene outcomes through both cultural perceptions and knowledge levels, with reusable and internal options fostering better management habits.

The correlation indicates that menstrual hygiene education, particularly on internal products, is essential for improving athlete hygiene behavior and reducing health risks.

#### 4. CONCLUSION

The present study investigated the impact of various menstrual hygiene products on physical fitness, comfort, and hygiene practices among female athletes engaged in gymnastics, swimming, athletics, and volleyball in Sri Lanka. The findings clearly demonstrate that menstrual hygiene management significantly influences not only the comfort and well-being of athletes but also their performance capabilities during menstruation.

A major highlight of the results was the unanimous demand (100%) for comprehensive awareness programs on menstrual health. This overwhelming agreement underscores a critical gap in current education systems and sports settings, indicating the urgent need for targeted interventions. Implementing structured awareness initiatives will be essential to destigmatize menstruation, empower female athletes, and ensure that they can participate fully and confidently in their sports without physical or psychological barriers.

The analysis revealed that menstrual hygiene product type had a notable impact on athletes' comfort and physical performance. Athletes using menstrual cups reported superior comfort levels, minimized physical restrictions, and improved mobility compared to those using tampons or sanitary pads. In particular, the advantages of menstrual cups including extended protection duration, reduced leakage, and enhanced freedom of movement were especially beneficial for athletes in both aquatic and high-intensity sports. Similarly, tampon users experienced comparatively better outcomes than pad users, although not to the same extent as menstrual cup users. Conversely, athletes relying on sanitary pads often faced considerable limitations, such as discomfort, chafing, and reduced performance efficiency, especially in demanding sporting environments.

The results of this study emphasize the impact of menstrual hygiene product choice on the physical fitness, comfort, and hygiene practices of female athletes in Sri Lanka. While there were no statistically significant differences in the 30m sprint ( $p = 0.158$ ), vertical jump ( $p = 0.735$ ), or 12-minute Cooper test ( $p = 0.763$ ), a significant difference was observed in agility performance

measured by the Agility T-test ( $p = 0.045$ ), suggesting that the type of menstrual product may influence certain aspects of athletic movement and responsiveness. Comfort levels were significantly higher among menstrual cup users ( $p = 0.012$ ), and hygiene practices also differed notably, with menstrual cup users reporting better practices ( $p = 0.003$ ).

Furthermore, users of tampons and menstrual cups reported greater satisfaction and fewer limitations during sports activities compared to those using sanitary pads. Overall, menstrual cups and tampons were associated with enhanced comfort, hygiene, and mobility, while sanitary pads were found to reduce comfort and restrict movement during athletic performance. These findings highlight the need to raise awareness about suitable menstrual products for active individuals and to improve access to options that support optimal athlete well-being and performance.

## 5. ACKNOWLEDGEMENT


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## 6. AUTHOR CONTRIBUTION STATEMENT

Author N.G.M.D.S designed the study, formulated the concept, enrolled the participants, collected data, analysed the data, revised the manuscript and read and approved the final manuscript. Author P.C.T supervised the entire research project; assisting author N.G.M.D.S in conceptualising the project, collecting and analysing the data. P.C.T further wrote the manuscript, reviewed the manuscript, read and approved the final manuscript.

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