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*Article*

# Deriving Profiles of Korea Ladies Professional Golf Association Players Using the Latent Profile Analysis Technique: Focusing on the Impact of the Menstrual Cycle

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**Abstract:** Menstruation is a significant periodical factor in women's lives, affecting them from menarche to menopause. This study investigates the menstrual status and its impact on the performance of Korea Ladies Professional Golf Association (KLPGA) 1st Tour players using Latent Profile Analysis (LPA). The study involved 119 female KLPGA tour license professionals who participated in over 30 tournaments annually, requiring them to manage their menstrual cycles during competitions. A questionnaire collected data on demographics, menstrual cycle characteristics, and training hours. Four distinct player profiles were identified based on self-esteem, anxiety, and perceived performance. Profile 4 exhibited the highest self-esteem and perceived performance with the lowest anxiety levels, while Profile 1 showed the highest anxiety levels and lowest self-esteem. Cross-tabulation and ANOVA analyses highlighted significant differences in practice hours and athletic experience across profiles. The findings suggest that regular menstrual cycles and athletic experience are crucial in defining player profiles. These insights are valuable for coaches and professionals to develop tailored training and management strategies to enhance performance. Future research should expand the sample size and employ longitudinal methods to validate these results.

**Keywords:** KLPGA; golf; women athletes; self-esteem; anxiety; perceived performance; menstrual medication usage

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## 1. Introduction

The Korea Ladies Professional Golf Association (KLPGA) was established in 1978 with four players. Since Se-ri Pak won the 1998 U.S. Women's Open, players such as In-bee Park, Jin-young Ko, and Sei-young Kim have won multiple titles in LPGA major tournaments and gained international fame. According to the Rolex Rankings, as of June 2024, there are about 27 Korean female golfers in the world's top 100, and the performance of Korean female golfers is aiming for the world's No. 1. The KLPGA Tour is divided into four tours: KLPGA Tour (First Division Tour), Dream Tour (Second Division Tour), Jump Tour (Third Division Tour), and Senior Tour(Over 40 years old). Among these, the KLPGA Tour is considered the dream stage for all Korean women professional golfers, with many players striving each year to qualify for the 1st Tour through various tours. The average age at KLPGA Tour players began playing golf is around 10 years old, and most players are active in their twenties, regularly experiencing menstruation while participating in tournaments.

For women's life, menstruation is almost periodical suffering factor [1]. From ages of 12 and 15, usually experience as first called as menarche. Then, Menstrual cycle take root for women's life to menopause, which usually generates between 45 and 55 years of age. Between menstruation and menopause. Menstrual cycle (MC) disorders often occur up to 20-30%, which called as "premenstrual syndrome (PMS)" and 20% suffers from "dysmenorrhea"[1].

For ordinary women, menstrual pain can disrupt normal life [2]. This is especially true for female athletes, whose focus is on maximizing performance. They generally aim to improve their performance through balanced training and recovery cycles. KLPGA Tour players participate in more than 30 tournaments each year. These tournaments involve walking for about six hours a day over three to four days, making it impossible to avoid their menstrual cycle. Therefore, female professional golfers sometimes take medication to alleviate symptoms related to their menstrual cycle and maintain their performance. These medications include oral contraceptives, painkillers, anti-inflammatory drugs, and hormone regulators. However, negative mood changes and depression are commonly reported side effects among women taking oral contraceptives. These mood changes or increased symptoms of depression are among the most common reasons for discontinuing contraceptive use [3,4].

For women athletes, optimizing performance is the focus of every athlete, who will usually aim to improve it through a balanced cycle of training and recovery phases. In so-called lean sports, performance is linked to bodyweight and body composition. This is reflected in a higher rate of cycle disorders (up to 79%) in these sports [5]. Related research about menstrual cycle[6] conducted female elite athletes with a focus on cycle disorders, contraception, and injuries in 2021, the other one analyzed with meta analysis about dysmenorrhea, which was the most prevalent MC disorder and mostly examined Pre and Real menstruation phases [7,8], and female athletes' characters relationship menstruation and performance (field hockey players) [9]. So, menstrual cycle issue is one of the main factors that influence about women athlete's performance. For example, in the case of high-level golf players, they have highest level of psychological skills (confidence, concentration, goal setting, anxiety control) [10] and overcome some obstructions [11]. Also, Compensate for the lacking parts in skills/psychology/experience through a coach [12,13].

Golf is predominantly recognized as a "mental game" that requires not only physical precision but also significant mental fortitude. Particularly, advancing to a first-tier tour status within the Korea Ladies Professional Golf Association (KLPGA) demands high levels of mental management. The distinct psychological and physiological characteristics of female players are pivotal, influencing various facets of their performance, especially in aspects demanding high precision such as confidence and training quality. This research aims to delve into the menstrual health status of KLPGA players, examining variables such as the regularity of menstrual cycles, use of medication, age at menarche, training hours, and overall career longevity through a structured questionnaire. Furthermore, we aim to categorize KLPGA players into distinct profiles using Latent Profile Analysis (LPA) to explore the nuanced differences between these groups. We also employ logistic regression analysis to determine significant classification factors that might impact these categories. Lastly, we conducted a comparative analysis of each group, a comparative analysis of each group, focusing on key psychological variables such as self-esteem, state anxiety, and perceived performance. This introduction sets the stage for a comprehensive exploration of how physiological and psychological factors intersect and influence the performance and training quality of professional female golfers in a highly competitive environment.

## 2. Research Methods

### *2.1. Participants*

The survey was conducted with all participants of the 2024 KLPGA first division tour, and out of the 130 respondents, data from 119 were analyzed after excluding duplicate and partial non-responders. The questionnaire trials were advertised through workshop of 2024 KLPGA Season, all participants were female(N=119) and has a tour license from top division to third division. See Table 1 for sample demographics, it has been found that the average time from starting golf (average 11.09) to obtaining a KLPGA professional license is approximately 7.38 years. Then, half of them responded about their training hours as 4 to 6 hours a day. Average winning experience for each division was 1.15 in 1st division, 0.83 2nd division, 0.37 3rd division. Average menstrual cycle days were 31.29 and menstruation days were 5.81 days. Additionally, 65.5% of participants responded their menstrual cycle as 'regularly', using a medicine during menstruation days were 42.9% of participants.

**Table 1.** Sample Characteristics of the participants.

| Variable | | M(SD) or n(%) N=119 |
|---|---|---|
| Age | | 24.61(±3.67) |
| Starting age for golf | | 11.09(±2.45) |
| KLPGA Pro Experience | | 6.14(±3.81) |
| Golf player's Experience | | 13.52(±3.45) |
| Training Hours | below 2hr/day | 3(2.5) |
| | 2-4hr/day | 27(22.7) |
| | 4-6hr/day | 56(47.1) |
| | 6-8hr/day | 25(21.0) |
| | 8-10/day | 7(5.9) |
| | above 10hr | 1(0.8) |
| Winning Experience | 1st division | 1.15(±2.88) |
| | 2nd division | 0.83(±1.08) |
| | 3rd division | 0.37(±0.64) |
| from first menarche to now | | 11.82(±3.89) |
| menstrual cycle | | 31.29(±9.66) |
| Average menstruation days | | 5.81(±0.97) |
| menstrual cycle's equality | Regularly | 78(65.5) |
| | Il-regularly | 41(34.5) |
| medication usage | Usage | 51(42.9) |
| | Non-Usage | 68(57.1) |

*2.2. Measures*

2.2.1. Demographics

Participants were asked to provide information on their age, age at which they started playing golf, the year they acquired their KLPGA professional license, and their daily training hours. Additionally, they reported their winning experience in each division, the year of their first menarche, details regarding their menstrual cycle, including average cycle length, average menstruation days, regularity of their menstrual cycle, and medication usage during menstruation. The data collected via the questionnaire were subsequently reprocessed to meet the specific requirements of the analysis.

2.2.2. Menstrual Cycle

For women athletes, optimizing performance is the focus of every athlete, who will usually aim to improve it through a balanced cycle of training and recovery phases. In so-called lean sports, performance is linked to bodyweight and body composition. This is reflected in a higher rate of cycle disorders (up to 79%) in these sports [5]. Related research about menstrual cycle [6] conducted female elite athletes with a focus on cycle disorders, contraception, and injuries in 2021, the other one analyzed with meta analysis about dysmenorrhea, which was the most prevalent MC disorder and mostly examined Pre and Real menstruation phases [7,8], and female athletes' characters relationship menstruation and performance (field hockey players) [9]. So, menstrual cycle issue is one of the main factors that influence about women athlete's performance. psychological skills (confidence, concentration, goal setting, anxiety control) [10] and overcome some obstructions [11]. Also, Compensate for the lacking parts in skills/psychology/experience through a coach [12,13]. Therefore, in this study, we included questions about the age of menarche, regularity or irregularity of the menstrual cycle, menstrual duration, and the use of medication during menstruation among Korean female professional golfers. To measure the relationship between the menstrual cycle and athletic performance, we divided the phases into pre-menstruation, menstruation, and post-menstruation.

#### 2.2.3. Perceived Performance, Self-esteem and Anxiety

The statistical analysis was conducted using SPSS version 26. Exploratory factor analysis (EFA) was performed to analyze the Perceived Performance Questionnaire, originally developed by Mamassis and Doganis (2004) and adapted by Kwak, Seol-yeong (2020) for our research purposes. This questionnaire consists of 8 items measured on a 5-point Likert scale. To assess its validity, exploratory factor analysis was conducted. The Bartlett's test of sphericity yielded a significant result, $\chi^2(df=28) = 757.322$, $p < .001$. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .794, indicating that the sample was suitable for this analysis. The reliability of the questionnaire was evaluated using Cronbach's $\alpha$, which resulted in a value of .884, suggesting high reliability [14].

In this study, we measured Self-Esteem using a modified version of Rosenberg's Self-Esteem Scale [15]. This scale was revised based on the research of Jeon, Byeong-gwan, Kim, Hong-seok, and Lee, Seung-ah [16]. The questionnaire consists of five items measured on a 5-point Likert scale. The exploratory factor analysis showed that Bartlett's test of sphericity was significant, $\chi^2(df=10) = 319.120$, $p < .001$, and the KMO measure was .849, indicating that the sample was adequate. The reliability of this scale was high, with a Cronbach's $\alpha$ value of .884 [18], and For measuring Competitive State Anxiety, we employed the Competitive State Anxiety Inventory-2 (CSAI-2) developed by Martens et al. (1990). This instrument consists of three sub-factors—somatic anxiety, cognitive anxiety, and state confidence—measured across 12 items on a 5-point Likert scale. Exploratory factor analysis for validity showed that Bartlett's test of sphericity was significant, $\chi^2(df=66) = 1006.922$, $p < .001$, with a KMO value of .881, confirming that the sample was suitable. In this study, a single factor approach was adopted. The reliability analysis yielded a Cronbach's $\alpha$ value of .720, which indicates a satisfactory level of reliability [19].

In conclusion, the reliability and validity analyses of the measurement instruments used in this study demonstrate that they were appropriately constructed and sufficiently reliable and valid for the purposes of this research.

### *2.3. Latent Profile Analysis*

To explore participant profiles based on self-esteem, anxiety, and perceived performance, we conducted a Latent Profile Analysis (LPA) to identify the levels of participants. The manual three-step approach was utilized with the BCH auxiliary function in Mplus 8.3. To determine the optimal number of classes, we fit a series of six LPA models for each sample, sequentially adding one class until the model fit was no longer acceptable. We then compared each model using several fit indices, including -2 Log Likelihood (-2LL), Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), Sample-Size Adjusted BIC (SSBIC), Consistent Akaike Information Criteria (CAIC), Approximate Weight of Evidence Criterion (AWE), the Lo–Mendell–Rubin adjusted likelihood ratio test (LMRT), and the bootstrapped likelihood ratio test (BLRT) [20].

Decreasing values among -2LL, AIC, BIC, SSBIC, CAIC, and AWE indicate improved model fit compared to the previous model [21]. The LMRT and BLRT were used to test the significance of the reduction in -2LL between a k-class model and a k-1 class model, thereby justifying the addition of an extra class [14]. We also assessed entropy, a measure of class separation ranging from 0 to 1, where values above 0.80 are considered preferable [22]. Following class enumeration, control variables such as age and race/ethnicity were included as covariates, and logits were used to fix classes prior to the outcome analysis [23].

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To assess class associations with self-esteem, perceived performance, and state anxiety scales, we used the auxiliary BCH approach [1]. This method fixes the parameters of the latent classes to ensure that the measurement of classes is not affected by covariate values such as self-esteem, perceived performance, and state anxiety. Additionally, to evaluate the mean differences on each scale between classes, we performed all pairwise comparisons using a pseudo-class Wald's chi-square test [25]. In all models, we controlled for menstrual cycle, medication usage, age of menarche, and career as a golf player. The analyses were conducted using Mplus 8.3

## 3. Results

### *3.1. Model Measures*

Based on the information criteria (AIC, BIC, SABIC), likelihood values (Log likelihood), entropy, and the significance of LMRT and BLRT, the optimal number of groups was determined to be four, as confirmed by Model 3 as the optimal profile. as reported in Table 2, Models 2, 3, and 4 have progressively better log likelihoods, suggesting improved fit with more profiles. The AIC and BIC values decrease across models, again indicating better model performance with additional profiles, although Model 4's improvement in BIC is marginal compared to Model 3, suggesting diminishing returns with adding more profiles. The Entropy value is very high in Models 3 and 4, suggesting very good classification certainty in these models. The LMR-LRT and BLRT results suggest that moving from Model 1 to Model 2, and from Model 2 to Model 3, provides a statistically significant improvement. However, the move from Model 3 to Model 4 does not yield a significant improvement according to the LMR-LRT, even though the BLRT suggests a slight improvement.

**Table 2.** Optimized Model by Latent Profile Analysis (LPA).

| Model # | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Log likelihood | -306.975 | -289.346 | **-277.432** | -272.251 |
| AIC | 633.951 | 606.692 | **590.864** | 588.502 |
| BIC | 661.742 | 645.600 | **640.888** | 649.643 |
| SABIC | 630.128 | 601.340 | **583.983** | 580.092 |
| LMR-LRT(ADJ) | 43.263(.110) | 33.506(.089) | **22.643(.048)** | 22.822(.054) |
| BLRT | -329.739(.000) | -306.975(.000) | **-289.346(.000)** | -284.259(.013) |
| Entropy | .659 | .867 | **.944** | .948 |
| profile 1(%) | 40(33.6%) | 32(26.9%) | **6(5.0%)** | 6(5.0%) |
| profile 2(%) | 79(66.4%) | 19(16.0%) | **66(55.5%)** | 1(0.8%) |
| profile 3(%) | | 68(57.1%) | **16(13.4%)** | 16(13.5%) |
| profile 4(%) | | | **31(26.1%)** | 32(26.9%) |
| profile 5(%) | | | | 64(53.8%) |

According to the results presented in Table 3, significant differences are observed across profiles in terms of self-esteem, anxiety, and perceived performance. Profile 4 exhibits the most positive psychological state, achieving the highest average scores in self-esteem (4.84) and perceived performance (3.96), along with the lowest average score in anxiety (2.52). Conversely, Profile 1 displays the least positive psychological state, with the lowest average scores in self-esteem (2.37) and perceived performance (2.63), and the highest average score in anxiety (3.37).

Profiles 2 and 3 are positioned in the middle. Profile 2 has an average self-esteem score of 4.00, a perceived performance score of 3.38, and an anxiety score of 2.75. Profile 3 reports average scores of 3.15 for self-esteem, 2.93 for anxiety, and 2.84 for perceived performance. These variances reveal a clear stratification of psychological states among the groups, indicating that each profile has unique psychological dimensions and necessitates specific interventions.

**Table 3.** Descriptive analysis by Profile.

| M(SE) | profile 1 | profile2 | profile3 | profile4 |
|---|---|---|---|---|
| Freq(%) | **6(5.0%)** | **66(55.5%)** | **16(13.4%)** | **31(26.1%)** |
| Self-esteem | 2.37(0.12) | 4.00(0.03) | 3.15(0.06) | **4.84(0.04)** |
| Anxiety | 3.37(0.22) | 2.75(0.05) | 2.93(0.08) | **2.52(0.08)** |
| Perceived Performance | 2.63(0.25) | 3.38(0.08) | 2.84(0.13) | **3.96(0.12)** |

The Analysis in Table 4, Cross Tabulation by Menstruation Cycle, Chi-Square Test Result ($X^2$ = 2.961, p = .398): As the p-value is greater than .05, we conclude that there is no significant difference in the distribution of menstruation cycle regularity (irregular vs. regular) across the profiles. This suggests that the menstruation cycle regularity is not significantly associated with the different profiles. Profiles 1 and 3 have an equal distribution of irregular and regular cycles (50% each). Profiles 2 and 4 show a higher percentage of regular cycles, with 68.2% and 71.0%, respectively. There is no significant association between menstruation cycle regularity and profile type.

**Table 4.** Cross Tabulation by menstruation cycle.

| By Cycle ($X^2$=2.961, p=.398) | | | Profile | | | | Total |
|---|---|---|---|---|---|---|---|
| | | | Profile 1 | Profile 2 | Profile 3 | Profile 4 | |
| cycle | Irregular | Freq | 3 | 21 | 8 | 9 | 41 |
| | | GROUP % | 50.0% | 31.8% | 50.0% | 29.0% | 34.5% |
| | Regular | Freq | 3 | 45 | 8 | 22 | 78 |
| | | GROUP % | 50.0% | 68.2% | 50.0% | 71.0% | 65.5% |
| Total | | Freq | 6 | 66 | 16 | 31 | 119 |
| | | GROUP % | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

Table 5, Cross Tabulation by Medication Use, Chi-Square Test Result ($X^2$ = .420, p = .936) As the p-value is much greater than .05, we conclude that there is no significant difference in the distribution of medication use (use vs. non-use) across the profiles. This suggests that medication use is not associated with the different profiles. Across all profiles, the percentage of medication use is similar, with between 56.1% to 66.7% of participants using medication. The non-use percentage ranges from 33.3% to 43.9%, indicating that approximately one-third to half of the participants in each profile do not use medication. There is no significant association between medication use and profile type.

**Table 5.** Cross Tabulation by medication use.

| By (medication use)($X^2$=.420, p=.936) | | | Profile | | | | Total |
|---|---|---|---|---|---|---|---|
| | | | Profile 1 | Profile 2 | Profile 3 | Profile 4 | |
| medication use | Use | Freq | 4 | 37 | 10 | 18 | 69 |
| | | GROUP % | 66.7% | 56.1% | 62.5% | 58.1% | 58.0% |
| | Non-use | Freq | 2 | 29 | 6 | 13 | 50 |
| | | GROUP % | 33.3% | 43.9% | 37.5% | 41.9% | 42.0% |

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| | | | | | | |
|---|---|---|---|---|---|---|
| Total | Freq | 6 | 66 | 16 | 31 | 119 |
| | GROUP % | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

Table 6, Cross Tabulation by Practice Hours, Chi-Square Test Result ($X^2 = 37.501$, $p = .005$) Since the p-value is less than .05, we can conclude that there is a significant difference in practice hours across the profiles. This suggests that practice hours are significantly associated with the different profiles. Profile 1, Participants are evenly distributed across different practice hour categories, with the majority (33.3%) practicing 4–6 hours.

Profile 2, The majority (53.0%) of participants report practicing 4–6 hours, with fewer in other categories. Profile 3, 37.5% of participants practice 4–6 hours, and 31.3% practice 6–8 hours, showing a trend toward longer practice times. Profile 4, Similarly to Profile 3, 38.7% practice 4–6 hours, and 32.3% practice 6–8 hours. Practice hours show a significant difference across profiles, with Profiles 2, 3, and 4 having more participants practicing 4 to 8 hours. Profile 1 shows more even distribution but with fewer participants practicing for long hours.

**Table 6.** Cross Tabulation by Practice Hours.

| **By (Practice Hours) ($X^2$=37.501, p=.005**)** | | | **Profile** | | | | **Total** |
|---|---|---|---|---|---|---|---|
| | | | **Profile 1** | **Profile 2** | **Profile 3** | **Profile 4** | |
| Practice Hours | ~2hr | Freq | 2 | 1 | 1 | 0 | 4 |
| | | GROUP % | 33.3% | 1.5% | 6.3% | 0.0% | 3.4% |
| | 2~4hr | Freq | 1 | **16** | 4 | 6 | 27 |
| | | GROUP % | 16.7% | **24.2%** | 25.0% | 19.4% | 22.7% |
| | 4~6hr | Freq | 2 | **35** | 6 | **12** | 55 |
| | | GROUP % | 33.3% | **53.0%** | 37.5% | **38.7%** | 46.2% |
| | 6~8hr | Freq | 1 | 9 | 5 | **10** | 25 |
| | | GROUP % | 16.7% | 13.6% | 31.3% | **32.3%** | 21.0% |
| | 8~10hr | Freq | 0 | 5 | 0 | **2** | 7 |
| | | GROUP % | 0.0% | 7.6% | 0.0% | **6.5%** | 5.9% |
| | 10hr~ | Freq | 0 | 0 | 0 | **1** | 1 |
| | | GROUP % | 0.0% | 0.0% | 0.0% | **3.2%** | .8% |
| Total | | Freq | 6 | 66 | 16 | 31 | 119 |
| | | GROUP % | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

*p<.05 **p<.01 ***p<.001.

The results reported in Table 7 provide a detailed comparison of athletic experience and post-menopausal duration across the different profiles using a one-way ANOVA test.

1. Athletic Experience

The ANOVA test for athletic experience shows a significant difference across the profiles, as indicated by the F-value of 3.008 and a p-value of .033 ($p < .05$). This suggests that the average years of athletic experience vary significantly among the profiles. Profile 1 has the highest mean athletic experience at 10.17 years, followed by Profile 3 with 7.00 years, Profile 4 with 5.87 years, and Profile 2 with the lowest average of 5.70 years. The overall average athletic experience across all profiles is 6.14 years.

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Post-hoc Scheffe Test: Although the ANOVA shows a significant difference in athletic experience, the post-hoc Scheffe test does not reveal specific group differences between the profiles, meaning that no pairwise comparison between profiles reached a significant level of difference.

2. Post-Menopausal Duration

The ANOVA test for post-menopausal duration shows no significant difference across the profiles (p = .158, which is greater than .05). This indicates that post-menopausal duration does not differ meaningfully between the profiles. Profile 1 has the longest mean post-menopausal duration at 15.00 years, while Profiles 2, 3, and 4 show means of 11.35 years, 12.06 years, and 12.10 years, respectively. However, these differences are not statistically significant. The analysis of athletic experience shows that there is a significant difference across profiles, with Profile 1 having the longest average experience. However, the post-menopausal duration does not show any significant variation between profiles, indicating that this variable is consistently distributed across the groups.

**Table 7.** Difference by Profile with One-way ANOVA.

| Variables | Profiles | N | Mean | SD | F | p |
|---|---|---|---|---|---|---|
| Experience | Profile 1 | 6 | 10.17 | 4.956 | 3.008 | .033* |
| | Profile 2 | 66 | 5.70 | 3.729 | | |
| | Profile 3 | 16 | 7.00 | 2.828 | | |
| | Profile 4 | 31 | 5.87 | 3.819 | | |
| | **Total** | **119** | **6.14** | **3.805** | | |
| post-menopausal duration | Profile 1 | 6 | 15.00 | 4.690 | 1.765 | .158 |
| | Profile 2 | 66 | 11.35 | 3.861 | | |
| | Profile 3 | 16 | 12.06 | 3.785 | | |
| | Profile 4 | 31 | 12.10 | 3.718 | | |
| | **Total** | **119** | **11.82** | **3.892** | | |

*p<.05 **p<.01 ***p<.001.

Verification of Predictors of Latent Profiles (Comparison of Group 1 with Groups 2, 3, and 4) In addition to the group comparisons, Table 8 provides a detailed verification of the predictors of latent profiles, using odds ratios (OR), standard errors (S.E.), and t-values for cycle regularity, medication use, athletic experience, and post-menopausal duration.

**Cycle Regularity**, the odds ratio for cycle regularity indicates that individuals with regular menstrual cycles are more likely to belong to **Profile 1** than to **Profile 4** (OR = 2.498). This means that regular cycles more than double the likelihood of belonging to Profile 1 compared to Profile 4.

**Medication Use**, the odds ratios for medication use across all profile comparisons are not statistically significant. This suggests that medication use does not play a substantial role in determining profile membership.

Athletic experience is a significant predictor of profile membership. The negative t-values for Profile 1 versus Profile 2 (-3.024**) and Profile 1 versus Profile 4 (-3.566***) indicate that as athletic experience increases, the likelihood of being classified into **Profile 1** significantly increases compared to **Profiles 2 and 4**.

Post-menopausal duration does not significantly influence profile membership, as indicated by the non-significant t-values across all profile comparisons.

The results of this analysis suggest that **athletic experience** and **menstrual cycle regularity** are significant predictors of latent profile membership. Increased athletic experience is associated with a higher likelihood of belonging to **Profile 1** and **Profile 3**, while regular menstrual cycles increase the probability of being classified into **Profile 2**. On the other hand, **medication use** and **post-menopausal duration** do not significantly affect profile classification. These findings highlight the importance of athletic experience and menstrual cycle regularity in distinguishing between latent

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profiles, while suggesting that other factors, such as medication use and post-menopausal duration, play a lesser role.

**Table 8.** Verification of Predictors of Latent Profiles (Comparison of Group 1 with Groups 2, 3, and 4).

| Reference | profile 1 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Comparing Groups | profile2 | | | profile3 | | | profile4 | | |
| | OR | S.E | t | OR | S.E | t | OR | S.E | t |
| Cycle (Regular=1) | 2.395 | 2.320 | .601 | 1.075 | 1.129 | .066 | 2.498 | 2.529 | .529 |
| Medication (Use=1) | 1.316 | 1.256 | .251 | 1.151 | 1.202 | .126 | 1.250 | 1.236 | .202 |
| Experience | **.724** | **.091** | **-3.024**** | .858 | .144 | -.984 | **.621** | **.106** | **-3.566***** |
| post-menopausal duration | 1.063 | .119 | .527 | .987 | .155 | -.082 | 1.287 | .210 | .171 |

*p<.05 **p<.01 ***p<.001.

The analysis in Table 9 provided seems to be summarizing the results of a logistic regression analysis, Cycle (Regular=1) Profile 2 vs. Profile 3: An OR of 0.449 (less than 1) suggests that being in a regular cycle is associated with a lower likelihood of being in Profile 3 compared to Profile 2. The t-value of -2.077 indicates that this is statistically significant. Profile 2 vs. Profile 4: An OR of 1.043 suggests almost no change in likelihood between these profiles in relation to the regularity of the cycle.

Medication (Use=1,) Both comparisons show ORs close to 1 (0.875 and 0.950), indicating a slight effect or no significant effect of medication use on the likelihood of being in either Profile 3 or 4 compared to Profile 2.

Experience, Profile 2 vs. Profile 3: An OR of 1.185 suggests a slightly higher likelihood of more experience associated with Profile 3. Profile 2 vs. Profile 4: An OR of 0.857 suggests a slightly lower likelihood of more experience associated with Profile 4.

Post-menopausal duration, Profile 2 vs. Profile 3: An OR of 0.929 suggests a lower likelihood of a longer post-menopausal duration associated with Profile 3. Profile 2 vs. Profile 4: An OR of 1.211 suggests a higher likelihood of a longer post-menopausal duration associated with Profile 4.

**Table 9.** Verification of Predictors of Latent Profiles (Comparison of Group 2 with Groups 3, 4).

| Reference | profile 2 | | | | | |
|---|---|---|---|---|---|---|
| Comparing Groups | profile3 | | | profile4 | | |
| | OR | S.E | t | OR | S.E | t |
| Cycle(Regular=1) | **.449** | **.266** | **-2.077*** | 1.043 | .528 | .081 |
| Medication(Use=1) | .875 | .523 | -.239 | .950 | .439 | -.114 |
| Experience | 1.185 | .166 | 1.120 | .857 | .127 | -1.124 |
| post-menopausal duration | .929 | .127 | -.562 | 1.211 | .169 | 1.246 |

*p<.05 **p<.01 ***p<.001.

The analysis in Table 10 provided comparing Profile 3 against Profile 4. Let's interpret the results, Medication (Use=1), OR (1.086) shows a very slight increase in the likelihood of being in Profile 4 with medication use, but this effect is minimal. S.E. (0.708), again showing substantial

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variability and suggesting that the estimate might not be very precise. t-value: 0.121, far from statistical significance.

Experience, OR( 0.723) indicates that greater experience is associated with a lower likelihood of being in Profile 4 compared to Profile 3. S.E.( 0.130), which is relatively small, suggesting a more precise estimate. t-value( -2.128), which is statistically significant, suggesting that the negative association between experience and being in Profile 4 compared to Profile 3 is statistically reliable.

Post-menopausal duration, OR( 1.304) indicates a 30.4% increased likelihood of being in Profile 4 with longer post-menopausal duration. S.E.( 0.225), indicating reasonable precision in this estimate. t-value( 1.350), which is not quite statistically significant but approaching the threshold for such.

**Table 10.** Verification of Predictors of Latent Profiles (Comparison of Group 3 with Group 4).

| **Reference** | | **profile 3** | |
|---|---|---|---|
| **Comparing Groups** | | **profile 4** | |
| | **OR** | **S.E** | **t** |
| Cycle(Regular=1) | 2.325 | 1.526 | .868 |
| Medication(Use=1) | 1.086 | .708 | .121 |
| Experience | **.723** | **.130** | **-2.128*** |
| post-menopausal duration | 1.304 | .225 | 1.350 |

*p<.05 **p<.01 ***p<.001.

## 4. Discussion

This study utilized Latent Profile Analysis (LPA) to explore the profiles of KLPGA tour players based on self-esteem, anxiety, and perceived performance. Additionally, demographic variables related to menstruation, such as the regularity of the menstrual cycle, medication usage, age of menarche, training hours, and career length as a golf player, were examined for group comparisons. The findings revealed several key insights.

Firstly, distinct characteristics were identified among the player groups. For instance, Group 4 was characterized by 70% of its members reporting regular menstrual cycles and higher confidence levels compared to the other groups. Previous studies have shown that irregular menstrual cycles are associated with approximately 74% higher perceived stress compared to regular cycles [26]. Physiologically, elevated cortisol levels have been linked to increased stress in cases of irregular menstrual cycles [27], emphasizing the importance of considering these factors as they indicate a connection between menstrual irregularity and heightened stress [28]. Specifically, early-onset irregular menstrual cycles have been associated with an 88% increase in stress levels, nearly double the likelihood of depression, and a threefold increase in the need for counseling, all of which can negatively impact overall life quality [29]. These findings support the conclusion that irregular menstrual cycles can have both psychological and physical repercussions, thus validating the results presented in this study. However, it was also noted that players in Group 4 tended to have shorter careers and practice more frequently. In contrast, Group 1 exhibited a tendency for decreased confidence and increased anxiety as players' careers lengthened, a finding that diverges from previous research [29]. For example, Profiles 2 and 4 showed average athletic careers of 5.70 and 5.87 years, respectively, while Profile 3 averaged 7 years. Profile 1, despite comprising only six athletes, had an average career length of 10 years. This may be attributed to the increased competition from emerging new athletes. In other words, when an athletic career exceeds six years, concerns about future career prospects may arise, similar to phenomena observed in professional sports like baseball and football.

Secondly, athletic experience and the regularity of menstrual cycles were key indicators for each group. As athletic experience increased, the likelihood of belonging to Profile 1 also increased. Specifically, compared to Profiles 2 and 4, the probability of belonging to Profile 1 was higher.

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Additionally, when comparing Groups 3 and 4, as athletic experience increased, the probability of belonging to Group 3 was higher than that for Group 4. Moreover, as menstrual cycles became more regular, the likelihood of belonging to Group 2 increased compared to Group 3.

Based on previous research, menstruation and cycle regularity are significant factors influencing perceived performance, self-esteem, and anxiety. These findings align closely with previous studies [6–9]. Additionally, these factors impact overall lifestyle, including both psychological and physical aspects [26–29]. The emergence of distinct profiles among KLPGA tour players, characterized by variations in self-esteem, perceived performance, and anxiety, represents a significant advancement in understanding the psychology of golfers compared to prior related research [10,11]. These results offer golf coaches and industry professionals a clearer understanding of player characteristics, providing valuable insights for future coaching strategies and game planning tailored to individual player tendencies. Specifically, these findings can serve as a valuable resource for research focusing on coach-player relationships [12,13].

However, this study has some limitations. Firstly, the sample is not representative, which may limit the generalizability of the findings to other female athletes. Additionally, the average age of the players was below 25, which may be considered a narrow age group. Secondly, the data were collected cross-sectionally, as the research was conducted just before the start of the 2024 KLPGA season, with challenges in recruiting survey respondents during the season. Therefore, future research should focus on creating an environment that fosters greater cooperation, allowing for a more comprehensive analysis of the impact of physical changes on female players' performance in the mentally demanding game of golf, ultimately aiding in the improvement of their performance.

Despite these limitations, this study aimed to investigate the impact of menstrual-related factors on performance among female professional golfers across various aspects. Notably, the study classified player characteristics into four major categories, which is expected to significantly aid future research theoretically. It also highlighted the need for a more scientific approach, potentially integrating biometric data, to further enhance understanding in this area.

Furthermore, this study provides insights by partially verifying the conventional wisdom regarding the impact of menstrual-related factors on performance. It suggests that there is some validation to the belief that menstrual cycle regularity correlates with improved performance, indicating implications for athletes' physical management practices.

This study has several limitations due to the sample-dependent nature of the profiling analysis strategy, which affects the generalizability of the findings. The following suggestions are made to address these limitations:

Issue of sample representativeness: The participants in this study were limited to KLPGA tour players, raising concerns about whether the results can be applied to other female athletes. Future research could enhance the generalizability of the findings by incorporating a more representative sample that includes female athletes of various age groups and from different sports disciplines.

Limitations of the cross-sectional research design: As this study collected data at a single point in time, it has limitations in analyzing the long-term relationship between the menstrual cycle and athletic performance. Future studies should consider using a longitudinal research design to explore the relationship between changes in the menstrual cycle and performance over time.

Age of the participants: The study focused on athletes with an average age below 25, which may limit the applicability of the findings to a broader age range. Future research should include participants from a wider range of ages to analyze how the relationship between the menstrual cycle and performance changes across different age groups.

Constraints in data collection cooperation: The study was conducted just before the start of the 2024 KLPGA season, which made it difficult to secure full cooperation from survey respondents. It is important for future research to create an environment where athletes can participate more actively, thereby improving the reliability and validity of the data collected.

Scientific approach to the relationship between menstrual factors and performance: While this study contributes to understanding the relationship between the menstrual cycle and performance, future research should incorporate more scientific approaches, such as biometric data, to enhance the

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precision of the analysis. This would provide more practical insights for managing athletes' performance.

By addressing these suggestions in future research, more comprehensive results can be achieved, and the understanding of the relationship between the menstrual cycle and athletic performance among female athletes can be further deepened.

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