Characteristics of the Menstrual Cycle According to the Sports Groups of the New Generation of Female Athletes

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ABSTRACT

PURPOSE To examine the characteristics of menstrual cycles in female athletes in different sports, comparison of possible deviations and changes associated with new generations of female athletes in training processes. METHODS The research included a total of 143 respondents (average age 17.46 ± 2.61; average training experience 8.67 ± 3.85) who were divided into three groups: sports games (n = 59), martial arts (n = 16) and aesthetic sports (n = 68). An anonymous online survey specially prepared for the needs of this research was conducted among the respondents. Ten questions were selected from the questionnaire examining demographic, training and menstrual cycle characteristics. The results were processed in the IBM SPSS program, v.26. Comparisons by sports categories were made using the Chi-square test for categorical variables and Kruskal-Walis analysis of variance for ordinal variables. In the case of significant differences obtained by Kruskal - Wallis analysis, the Dunn-Bonferroni post hoc test was performed to determine between which groups there is a difference. A logistic regression analysis was performed to predict the regularity of the menstrual cycle using age, length and duration of training and sport category. RESULTS The groups of sports do not differ from each other with regard to cycle regularity ($p = 0.088$). There are no differences between sports groups ($p = 0.935$) in cycle changes. There is also no difference in duration ($p = 0.883$) and abundance of bleeding ($p = 0.700$). CONCLUSION The examined characteristics of the menstrual cycle of the new generation of female athletes according to the sports groups in this research did not show significant changes except in martial arts (43.8 %). Although there is a common difference in the training duration of individual sports groups, future research and monitoring of the menstrual cycle in female athletes should be further reduced according to the possible effects on the reproductive and general health of female athletes.

Keywords: menstrual cycle, sport, women

INTRODUCTION

Monitoring the reproductive and general health of female athletes in sports through the menstrual cycle is an indicator of the modernity of training processes and a significant factor in achieving the desired sports results, especially during competitions. For women in sports, special attention should be paid to the menstrual cycle.

This research puts in focus the new, young, generation of female athletes as the majority of participants are younger than twenty and are not in the senior category of their sport.

Research has shown different effects of physical efforts in female athletes and women in sports in general (Nose et al, 2020; De Souza, 1990; Mhenni et al, 2017). The risk for the occurrence of disorders does not only refer to disorders of the menstrual cycle and the impact on the reproductive health of female athletes, but also to disorders of other systems (Roeder, 2021; Ellegård et al, 2007). Monitoring the menstrual cycle in female athletes affects the health of female athletes in general. The change in hormone levels during the menstrual cycle consequently affects the ability of female athletes. In the analyzes of competition strategies and training processes, the results of the same are related to the performances of female athletes in relation to the influence of menstrual phases on physiological performance components such as muscle strength, endurance and strength. The training process should be adapted to the cycle so that female athletes are ready for major competitions (Carmichael et al, 2021). During periods of intense competition, possible causes of menstrual cycle disturbances include excessive exercise or overtraining that causes an increase in muscle mass relative to fat tissue, which can cause menstruation to be absent (Dušek, 2001).

Recommendations and alignment of the menstrual cycle with the training or competition calendar show that aerobic training and strength training should be reduced during the late luteal phase of the cycle, while anaerobic performance should most often be reduced in the late follicular phase of the cycle. The late luteal phase of the cycle was also one of the phases in which the athletes themselves noticed that their strength decreased. Research (Janse de Jonge, 2003) that reveals that the menstrual cycle has a mediating role in physical performance shows that the phases affect strength, aerobic and anaerobic performance differently. When training is modified based on all phases of the menstrual cycle, the predominant performance variable used and training goals must be carefully considered (Janse de Jonge, 2003). According to the studies, some perceptual responses are affected during different phases of the menstrual cycle, but different methodological approaches and the variability of the phases assessed in different studies limit generalization and prevent precise conclusions to be made (Paludo et al., 2022).

Although there are few research on the menstrual cycle in women in sports, this research shows that monitoring the menstrual cycle would represent an important management tool in harmonizing training processes and competition calendars. But that, unfortunately, is not practical because right now, there is not enough evidence and studies that could justify the resources and money needed for monitoring the menstrual cycle for training periodization (Julian & Sargent, 2020).

In general, the concept of the menstrual cycle is not updated due to socially accepted attitudes and norms that were often associated with prejudices. However, opening the issue of women in sports and monitoring the impact of sports on the reproductive health of women in sports has

changed attitudes and acceptance. Discussions and analyzes in the research sense contributed to the acceptance of the physiological process of the menstrual cycle discount in the public, which indicated the possibility of accepting different views (Roberts & Garling, 1981). Prejudices about the non-significance of the menstrual cycle in the contribution of different performance improvements in the performance of female athletes were slowly abandoned.

The aim of this research was to examine the characteristics of menstrual cycles in female athletes in different sports, a comparison of possible deviations and changes associated with new generations of female athletes in training processes.

METHODS

Participants

The research included a total of 143 respondents who were divided into three groups: sports games (n = 59), martial arts (n = 16) and aesthetic sports (n=68). The group of sports included subjects from the following sports: athletics, running, volleyball, cycling, swimming, handball, football, basketball. In the group of martial sports: karate, taekwondo, wrestling and judo and in the group of aesthetic sports: gymnastics, dance and synchronized swimming. The participants were recruited online from the sport clubs in Zagreb, Croatia, except in the group of synchronized swimmers where 7 participants are from club in Rijeka, Croatia. The recruitment was from November, 2021. until March 2022. The inclusion criterion was that the participants were at least 12 years old and actively engaged in sports, and the exclusion criterion was that they did not have menstruation. The study has ethical approval (Ethical Commission "Medveščak" Synchronized Swimming Club; 01-2/2022-11) and all the participants were explained what is the study about and asked whether they want to participate.

Procedures

An anonymous survey was conducted among the respondents to collect information, which consisted of 27 questions, of which 10 questions were selected from the survey and processed for the purposes of this research. Selected questions collected demographic information about respondents (age, height and weight), their training characteristics (sport discipline, years of training experience, frequency of training and duration of single training) and charactestics of their menstrual cycle (having a regular cycle of 28 days, noticing any changes in the menstrual cycle, duration of bleeding in days and abundance of bleeding). Sport discipline, age, height, weight and years of training experience were open questions, frequency of training, duration of single training, duration of bleeding and abundance of bleeding were multiple choices questions and having a regular cycle and noticing changes in the cycle were yes/no questions. The survey was conducted anonymously with the consent of the respondents for the processing of research data.

Statistical analysis

The results were processed in the IBM SPSS program, v.26. Comparisons by sports categories were made using the Chi-square test for categorical variables (cycle regularity, changes in the cycle, sports group) and the Kruskal-Walis analysis of variance for ordinal variables (training frequency, duration of training, duration of bleeding, profuse bleeding). In the case of significant differences

obtained by Kruskal - Wallis analysis, a Dunn-Bonferroni post hoc test was performed to determine between which groups there is a difference. A logistic regression analysis was performed to predict the regularity of the menstrual cycle using age, length and duration of training and sport category. The significance level was set at $p < 0.05$.

RESULTS

Table 1 shows the values of the respondents in terms of age, height, weight and training experience depending on the group of sports they are training in and overall at the level of the entire sample.

Table 1. General characteristics of the respondents

	age (years)	**height (cm)**	**weight (kg)**	**training experience (years)**
sports games (n=59)	17.17 ± 2.26	172.66 ± 6.73	62.81 ± 7.27	8.55 ± 2.84
martial arts (n=16)	18.20 ± 1.15	168.19 ± 7.30	63.63 ± 8.89	7.58 ± 4.41
aesthetic sports (n=68)	16.78 ± 2.80	167.78 ± 7.24	58.02 ± 8.19	9.50 ± 3.39
total (n=143)	17.46 ± 2.61	169.46 ± 7.31	60.80 ± 8.75	8.67 ± 3.85

Table 2. Frequency and duration of training

	training frequency (x per week)				**training duration (hours)**		
	3–4	**4–5**	**5–6**	**> 7**	**< 2**	**2–3**	**> 3**
sports games	13.6%	18.6%	20.3 %**	47.5%	33.9 %	64.4 %**	1.7 %
average rank	76.79				64.51		
martial arts	25.0 %	12.5%	18.8 %**	43.8 %	81.3 %**	18.8%	0.0 %
average rank	70.72				32.38		
aesthetic sports	20.6 %	13.2 %	32.4 %**	33.8 %	8.8 %	76.5 %**	14.7 %
average rank	68.15				87.82		
H	1.54				37.62		
p	0.464				0.000		

** the category in which the median score is located

Table 2 shows that the frequency of training is the same for all three groups of sports, while martial arts have slightly shorter training sessions. The significance of these differences was confirmed by the Kruskal-Wallis test. The Bonferroni test showed that all three groups differ significantly in terms of training duration: martial sports have shorter training sessions than the sports game group training ($p = 0.003$) and aesthetic sports training ($p = 0.000$). Aesthetic sports have longer training sessions than sports games ($p = 0.000$).

It was checked whether female athletes differ in the regularity of the menstrual cycle and the perception of changes in it, according to their sports disciplines (Table 3) and the characteristics of the menstrual cycle (Table 4).

Table 3. Characteristics of the menstrual cycle with regard to the sport group

	cycle regularity		**changes in the cycle**	
	YES	NO	YES	NO
sports games	48 (81.4 %)	11 (18.6 %)	17 (28.8 %)	42 (71.2 %)
martial arts	9 (56.3 %)	7 (43.8 %)	4 (25.0 %)	12 (75.0 %)
aesthetic sports	47 (69.1 %)	21 (30.9 %)	18 (26.5 %)	50 (73.5 %)
X2 (p)	4.851 (0.088)		0.134 (0.935)	

Table 4 Differences in menstrual bleeding characteristics

	Kruskal-Wallis analysis of variance – duration of bleeding		**Kruskal-Wallis analysis of variance – profuse bleeding**	
	median	average rank	M	average rank
sports games	2.00	73.58	3.27	75.05
martial arts	2.00	72.56	3.13	67.38
aesthetic sports	2.00	70.50	3.13	70.44
H (p)	0.25 (0.883)		0.71 (0.700)	

The groups of sports do not differ from each other with regard to cycle regularity (p = 0.088), although it can be inferred that the proportion of girls with irregular cycles is slightly higher in martial arts, but this difference is not statistically significant at the 5 % level. As for the existence of changes in the cycle, there are no differences between the sports groups (p = 0.935). There is also no difference in duration (p = 0.883) and abundance of bleeding (p = 0.700).

It was checked whether the regularity of the menstrual cycle can be predicted using age, sport group and the frequency and duration of training. Logistic regression showed that there are no significant predictors for predicting cycle regularity (Table 5).

Table 5 Prediction of menstrual cycle regularity with age, sport group, duration and frequency of training

	Wald	**df**	**p**
age	0.020	1	0.889
sports group	4.117	2	0.128
training frequency	3.308	3	0.347
training duration	1.386	2	0.500

DISCUSION

This study showed no difference between groups of sport in frequency in training (p = 0.464), menstrual cycle regularity (p = 0.088) nor changes in the cycle (p = 0.935). Also, groups do not differ significantly in duration (p = 0.883) or abundance of bleeding (p = 0.700). All three groups differ significantly in training duration (p = 0.000): aesthetic sports have longest trainings and martial sports have shortest trainings. Age, sport group and training frequency and duration cannot succesfully predict menstrual cycle regularity. Several components are important for the health of female athletes of reproductive age related to the menstrual cycle. It includes the analysis of training duration, regularity of the menstrual cycle, the existence of changes in the cycle, especially related to the duration and abundance, and possible predictions of the regularity of the cycle, which are important for the competition calendar and planning the preparation of athletes for important competitions, i.e. the achievement of target results.

The phases of the menstrual cycle carry several psychophysiological changes; however, studies investigating the impact of menstrual cycle phases on training load or technical training are rare. Cristina-Souza et al. (2019) investigated the effect of follicular phase , ovulatory phase and luteal phase on training load and technical training in young athletes. Twelve female athletes performed regular daily training sessions with the rating of perceived exertion and duration recorded for each training session. These findings suggest that menstrual cycle disturbances were elevated during follicular phase, indicating that monitoring menstrual cycle phases may provide important feedback for training programming and expected performance during competition (Cristina-Souza et al., 2019).

All three groups of sports in this research showed a significant difference in the duration of training, which is expected due to the characteristics of different sports, but the duration did not show a connection with changes in the menstrual cycle.

Future martial sports have shorter training sessions than those from the sports games group (p = 0.003) and from aesthetic sports training (p = 0.000). In this research, a change in the menstrual cycle was observed in the athletes from the martial sports group, although it was not statistically significant. For now, no such observation can be linked, so future research will need to show the possible impact.

It was checked whether the regularity of the menstrual cycle can be predicted using age, sport group and the frequency and duration of training. Logistic regression showed that there are no significant predictors for predicting cycle regularity. Certain studies (Oliveira et al., 2021) show the development of models for predicting the regularity of the menstrual cycle in female athletes, such as a hybrid predictive model, but it is more focused on predicting the length of the menstrual cycle (Oliveira et al., 2021).

Meignié et al. (2021) state that during the menstrual cycle among top female athletes, various parameters related to sports performance are affected, but the parameters themselves and the size and direction of the effects are not convincing.

Women participating in a wide range of competitive sports are at higher risk of developing eating disorders, menstrual irregularities and osteoporosis, which are generally referred to as the 'female athlete triad' (Quah et al., 2009).

According to previous studies, the prevalence of the female athlete triad is relatively low, but the prevalence for individual triad component may be high, especially in athletes practicing sports that require a lean physique (Quah et al., 2009). On a group of 67 elite Malaysian athletes, Quah et al. (2009) registered a prevalence of 47.6 % of subjects who were at risk of menstrual irregularity among lean athletes, and 14.3 % among non-lean athletes.

The identification of the existence of any of the triad components is crucial since all of them are unequivocally linked and may lead to an accumulation of dysfunctions with a possible higher risk of injury (especially fracture). This is especially important for women participating in sports that emphasize a lean physique and in weight-restricting sports such as gymnastics and competitive martial arts (Quah et al., 2009). The influence of such changes is probably also the reason for the higher irregularity of menstrual cycles was observed in martial arts (43.8 %) in this study.

The results of research in this area are contradictory, and each new study is a step towards a better understanding of the complexity of the relationship between sports activity and the regularity of the menstrual cycle. It is a multifactorial phenomenon in which factors related to the athlete's health as well as those linked to the training load plays an important role. There is also growing evidence for a link between female sex hormones and health, including a relationship between melatonin, menstrual dysfunction and breast cancer, but the mechanisms for and consequences of these relations are yet to be elucidated (Dawson & Reilly, 2009). Recently, Adam et al. (2022) suggested that there are not differences in rates or experiences of menstrual function and dysfunction based on competition level, sport type, or sport category. Based on an online survey, conducted on a sample of 63 female athletes, between 14 and 39 years of age, they also state that most athletes experience some form of menstrual dysfunction, for which they usually do not seek assistance. This highlights two possibilities: a) the existence of additional "unregistered" disturbances related to the menstrual cycle, both in this and in previous research, and b) the importance of creating an atmosphere for open communication in the sports environment.

CONCLUSIONS

The groups of sports do not different from each other regarding regularity and changes in the menstrual cycle, duration and abundance of bleeding. A slightly higher irregularity of menstrual cycles was observed in martial arts (43.8 %). The research showed that for now there are no significant predictors for predicting the regularity of menstrual cycles in female athletes, and further research should include tests of different training durations and possible effects on the reproductive health of female athletes.

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