Factors influencing the regularity of the menstrual cycle in Polish university female students[1]

Katarzyna Kanadys[a] ✉, Karolina Kościuszko[b], Grażyna Stadnicka[c], Katarzyna Piasecka[d], Ewa Ślizień-Kuczapska[e], Anna Pilewska-Kozak[f]

[a] Katarzyna Maria Kanadys[2, 4], https://orcid.org/0000-0001-8447-3937
[b] Karolina Kościuszko[3], https://orcid.org/0009-0004-7151-9034
[c] Grażyna Stadnicka[4], https://orcid.org/0000-0002-5850-3247
[d] Katarzyna Piasecka[2, 5], https://orcid.org/ 0000-0002-3717-5926
[e] Ewa Ślizień-Kuczapska[1, 2], https://orcid.org/0000-0002-2227-3849
[f] Anna Bogusława Pilewska-Kozak[4], https://orcid.org/0000-0003-4562-2295
✉ Corresponding author: Katarzyna Maria Kanadys, kanadysk@wp.pl

[1] Childbirth in the Żelazna Medical Center, St. Sophia's Specialist Hospital in Warsaw
[2] Scientific Committee of the Polish Association of Natural Family Planning Teachers
[3] Independent Public Health Care Facility in Siedlce
[4] Department of Obstetrics and Gynaecology Nursing, Chair of Obstetrics and Gynaecology, Faculty of Health Sciences, Medical University of Lublin. Poland
[5] Department of Family and Geriatric Nursing, Chair of Integrated Nursing Care, Medical University of Lublin, Poland

Abstract: *Introduction:* The regularity of the menstrual cycle is one of the key indicators of procreation health. The frequency of menstruation disorders in young women, including students, may result from various socio-demographic and lifestyle-related factors. The aim of the study was to examine whether the regularity of Polish female students' menstrual cycles depended on selected socio-demographic variables and their lifestyle. *Material and method:* The study involved 490 Polish female university students over the age of 18, representing various fields of study. The study was carried out in the form of an anonymous online questionnaire from November 2022 to March 2023. A diagnostic survey method was used, employing a bespoke questionnaire. Socio-demographic data, lifestyle (for example, sleep, physical activity, stress, drugs), characteristics of the menstrual cycle and the occurrence of accompanying symptoms were analysed. Statistical analysis was performed (chi-square test, p < 0.05). *Results:* 30% of participants reported irregular menstrual cycles. Among the analysed variables, only the year of studies (p = 0.024), smoking (p = 0.006) and eating breakfast every day (p = 0.014) showed a statistically significant relationship with the cycle regularity. Students in higher years of their studies, non-smokers and those who ate breakfast every day were more likely to report regular menstruation. *Conclusions:* Nearly one in three students had irregular menstruation cycles, which may indicate actual and potential health problems. Therefore, it is necessary to identify factors related to irregular menstruation to determine appropriate preventive and remedial strategies. Irregular menstrual cycles were significantly more common among respondents who were in their first years of studies. The rest analysed socio-demographic variables did not differentiate the group of study participants. Smoking tobacco and skipping breakfast were strongly associated with irregular menstruation, which highlights the importance of modifiable lifestyle factors in the prevention and promotion of procreation health.

Keywords: lifestyle, irregular menstrual cycle, risk factors, university female students

1. Introduction

Menstrual cycle is a complex physiological process of transformation taking place in a woman's body, which covers dynamic hormonal changes within the hypothalamic – pituitary–ovarian axis and the endo-metrium. As a result, every month there is bleeding, called a period or menstruation, which is an external manifestation of cyclical changed of the endometrium (Pawelczyk, Banaszewska 2020). The first menstrual

---

1 Article in Polish language: https://stowarzyszeniefidesetratio.pl/fer/63P_Kana.pdf

cycles occurring during adolescence may be irregular and anovulatory – it is a physiological phenomenon related to the maturing of the neuroendocrine regulatory system. The age of menarche and cycle regularity at that time may be influenced by genetic, family, ethnic, environmental, socioeconomic, and lifestyle factors, such as diet, physical activity, sleep, stress, and disease. Over time, usually in five years from menarche, the cycle stabilizes and ovulation becomes regular (Carlson, Shaw, 2019; Drosdzol-Cop, Orszulak, Wilk, 2020; Saei Ghare Naz, Farahmand, Dashti, Ramezani Tehrani, 2022). According to the classic definition, regular menstruation (*eumenorrhoea*) means cycles of 28 ± 5 days, with the loss of 30-70 ml of blood, and duration of 3-4 days (Jarząbek-Bielecka, Sowińska-Przepiera, Kędzia, Kędzia, 2019). In turn, experts from the International Federation of Gynecology and Obstetrics (FIGO) have defined a regular menstrual cycle as one that occurs every 24–38 days, lasts no longer than 8 days, and varies in duration by no more than 10 days throughout the year (Munro, Critchley, Fraser, Committee FMD, Haththotuwa, Kriplani, et al., 2018). A regular menstrual cycle is considered to be one of the major indicators of reproduction health and the overall well-being of a woman (Alhammadi, Albogmi, Alzahrani, Shalabi, Fatta, AlBasri, 2022).

Menstrual cycle irregularities – including disorders of rhythm, volume, or the presence of additional bleeding – are classified as menstrual disorders and may be the result of hypothalamic-pituitary-ovarian axis dysfunction, metabolic diseases, or the effect of iatrogenic interventions. It is estimated that even 75% of girls and young women in the developmental age experience at least one menstrual disorder, which makes the problem one of the most common reasons for visits to gynecologists in this age group (Alhammadi et. al., 2022; Jarząbek-Bielecka i in., 2019; Podfigurna, Męczekalski, 2020). Irregular menstrual cycles, if chronic, may be a risk factor for serious health complications in the future, such as osteoporosis, polycystic ovarian syndrome (PCOS), infertility, type 2 diabetes, cardiovascular diseases or endocrine disorders (Jeon, Baek, 2023; Mittiku, Mekonen, Wogie, Tizazu, Wake, 2022; Rostami Dovom, Ramezani Tehrani, Djalalinia, Cheraghi, Behboudi Gandavani, Azizi, 2016). Identification

of the risk factors that contribute to the development of the menstrual cycle disorders is therefore of considerable preventive and clinical importance.

Contemporary research indicates that lifestyle plays a key role in the etiopathogenesis of menstruation disorders. Students in particular are a group of women who are highly vulnerable to risk factors such as emotional stress, sleep disorders, insufficient physical activity, poor diet, substance abuse, and environmental changes associated with moving and adapting to a new lifestyle (Alhammadi, et. al. 2022; Demeke, Zeru, Tesfahun, Mohammed, 2023; Nguyen, Le, 2024; Mittiku et. al., 2022; Negi, Mishra, Lakhera, 2018; Shantha, Roselin, Srisanthanakrishnan, 2020). High academic expectations, pressure to achieve and lack of emotional stability may lead to the HPA (hypothalamic-pituitary-adrenal) stress axis activation, which disrupts hormonal regulation of the reproductive system if chronically active.

More and more research emphasizes the necessity to educate young women in menstruation disorders prevention by promoting healthy eating habits, proper sleep hygiene, stress management, and regular physical activity (Fujiwara, Ono, Iizuka, Sekizuka-Kagami, Maida, Adachi, Fujiwara, Yoshikawa, 2020; Jha, Bhadoria, Bahurupi, Gawande, Jain, Chaturvedi, Kishore, 2020; Maekawa, Miyamoto, Ariyoshi, Miura, 2023; Negi et, al., 2018). Educational measures of this type may not only improve the quality of life, but also prevent more serious health implications in the future (Fernández-Martínez, Fernández-Villa, Amezcua-Prieto, Suárez-Varela. Mateos-Campos, Ayán-Pérez, Molina de la Torre, Ortíz-Moncada, Almaraz, Blázquez Abellán, Delgado-Rodríguez, Alonso-Molero, Martínez-Ruíz, Llopis-Morales, Valero Juan, Cancela Carral, Martín-Peláez, Alguacil, 2020). What is more, implementing programmes to encourage self-observation of the menstrual cycle in schools and at universities which would allow early diagnosis and treatment of occurring disorders (Jha, et. al., 2020; Piasecka, Łyszczarz, Pytka, Ślizień-Kuczapska, Kanadys, 2021).

Given the above, it seems reasonable to conduct in-depth research aimed at identifying and assessing risk factors associated with irregular menstrual cycles among Polish students. This would not only make

it possible to understand the scale of the problem in this population, but would also serve as a starting point for developing effective educational and preventive measures.

Aim of the study: The aim of the study was to examine whether the regularity of Polish female students' menstrual cycles depended on selected socio-demographic variables and their lifestyle.

2. Material and method

The study involved 490 female students from universities located in Poland. The study was conducted between November 2022 and March 2023. The criteria for inclusion in the study group were: female gender, age over 18, university student, regardless of the type of studies. The criteria for exclusion from the study group were hormonal contraception, pregnancy, and breastfeeding. The study was carried out online, using a Google form. The respondents consciously agreed to participate in the survey, which was voluntary and anonymous. Before participating in the study, students were informed about its aim, nature, and course.

The study was conducted using a diagnostic survey method with a questionnaire designed specifically for this research. The questionnaire consisted of 30 closed questions. The first questions concerned the socio-demographic data of the respondents (1-8). The following questions referred to the students' lifestyle (9-15) and health problems and perceived stress (16-19). The remaining questions concerned the characteristics of the menstrual cycle (20-30).

The collected research material was statistically processed using the IBM SPSS Statistics, version 27, package. First, the number and percentage of response categories for each question are given. Appropriate statistical procedures were used to verify the hypotheses. The relationship between qualitative variables was tested using the chi-square test of independence. This test is based on a comparison between observed (empirical) values and theoretical (expected) values, that is, values calculated assuming that there is no relationship between the variables.

The results of the analysis obtained were assumed to be statistically significant at a significance level lower than 0.05 ($p < 0,05$).

3. Results of the study

The study involved 490 women, from which 51.6% were 23 years old or more, and 48.4% were 18-22 years old. The majority of participants in the study (77.6%) stated that they lived in a city during their studies, while 22.4% lived in the countryside. Looking at the major, 41.6% of respondents studied medicine or biology, 30.8% studied humanities, and 27.6% studied technical or mathematical subjects. An analysis of the distribution of years of study showed that 17.1% of respondents were first-year students, 14.5% were second-year students, 13.7% were third-year students, and the largest group consisted of fourth- and fifth-year students (54.7%). The majority of respondents (93.1%) remained unmarried, with 6.9% married. The financial situation was assessed as very good by 19% of respondents, as good – 49%, with 32% assessing it as mediocre or bad. In relation to the body mass index (BMI), it was within the normal range for 72% of respondents. 9.8% of respondents were underweight, while 18.2% of them was overweight or obese. The majority of women (68.6%) had menarche when they were 12-14 years old, for 25.7% the first period took place when they were 11 years old or younger, and for 5.7% – when they were 15 years old or older. Regular menstruation was reported by 70% of respondents and 30% reported irregular cycles. The majority of women (60.2%) described the intensity of bleeding as moderate, 33.9% as light, and 5.9% as heavy. Painful menstruation was reported by 66.1% of participants, while 33.9% did not experience any pain. The most commonly reported pain intensity was between 4 and 6 on a scale of 0 to 10 (45.1%). In 35.3% of respondents, pain was rated between 0 and 3, and in 19.6% between 7 and 10. Painkillers were used by 64.3% of respondents in connection with menstrual discomfort.

The following part of the presentation of the study results shows the analysis of the relationships between selected socio-demographic factors and the cycle regularity in respondents, the results obtained are shown in Table 1.

K. Kanadys, K. Kościuszko, G. Stadnicka, K. Piasecka, E. Ślizień-Kuczapska, A. Pilewska-Kozak

Based on our own research, it was found that women aged 23 and older who were surveyed had regular menstrual cycles more often (71.5%) than those aged 18-22 (68.4%). Women living in rural areas had regular menstrual cycles (70.9%) slightly more often than women living in a city (69.7%). Moreover, students of medicine/biology had regular menstrual cycles more often (73.5%) than respondents studying humanities (68.2%) and technical/mathematical subjects (66.7%). When it comes to the year of studies, the research indicated significant differences because fourth- and fifth-year students were statistically more likely to have regular menstrual cycles (74.6%) than first-year (57.1%), second-year (69%), and third-year students (68.7%). Moreover, the respondents who were underweight had regular menstrual cycles more often (77.1%) than those with the proper BMI (68.8%) and those who were overweight/obese (70.8%), but the differences were not statistically important. The statistical analysis of the examined variables did not show any statistically significant relationship ($p > 0.05$) between

Table 1. Socio-demographic factors and regularity of the cycle of examined students

	Socio-demographic factors		Menstrual cycle regularity		Total	χ^2
			Yes	No		p
Age	18-22 y.o.	n	162	75	237	0.45
		%	68.40%	31.60%	100.00%	0.502
	23 y.o. or more	n	181	72	253	
		%	71.50%	28.50%	100.00%	
Place of residence during studies	Urban areas	n	265	115	380	0.014
		%	69.70%	30.30%	100.00%	0.906
	Rural areas	n	78	32	110	
		%	70.90%	29.10%	100.00%	
Field of study	Medicine /biology	n	150	54	204	2.145
		%	73.50%	26.50%	100.00%	0.341
	Humanities	n	103	48	151	
		%	68.20%	31.80%	100.00%	
	Technical / mathematics	n	90	45	135	
		%	66.70%	33.30%	100.00%	
Year of study	I	n	48	36	84	9.435
		%	57.10%	42.90%	100.00%	0.024
	II	n	49	22	71	
		%	69.00%	31.00%	100.00%	
	III	n	46	21	67	
		%	68.70%	31.30%	100.00%	
	IV and V	n	200	68	268	
		%	74.60%	25.40%	100.00%	
BMI	Underweight	n	37	11	48	1.4
		%	77.10%	22.90%	100.00%	0.497
	Right BMI	n	243	110	353	
		%	68.80%	31.20%	100.00%	
	Overweight / obesity	n	63	26	89	
		%	70.80%	29.20%	100.00%	
	Total	n	343	147	490	
		%	70.00%	30.00%	100.00%	

Table 2. Lifestyle-related factors and regularity of the menstrual cycle of examined university female students

Elements of female students' lifestyle			Menstrual cycle regularity		Total	χ^2
			Yes	No		p
Smoking	Yes	n	55	40	95	
		%	57,90%	42,10%	100,00%	7,524
	No	n	288	107	395	0,006
		%	72,90%	27,10%	100,00%	
Frequency of feeling stressed	Rarely	n	105	37	142	
		%	73,90%	26,10%	100,00%	
	Quite often	n	153	75	228	2,001
		%	67,10%	32,90%	100,00%	0,368
	Often	n	85	35	120	
		%	70,80%	29,20%	100,00%	
Eating breakfast every day	Yes	n	235	83	318	
		%	73,90%	26,10%	100,00%	6,041
	No	n	108	64	172	0,014
		%	62,80%	37,20%	100,00%	
Sleeping time	6 hours or less	n	108	51	159	
		%	67,90%	32,10%	100,00%	
	7-8 hours	n	201	81	282	0,554
		%	71,30%	28,70%	100,00%	0,758
	More than 8 hours	n	34	15	49	
		%	69,40%	30,60%	100,00%	
Frequency of physical activity	I do not exercise	n	98	43	141	
		%	69,50%	30,50%	100,00%	
	Less than 3 times a week	n	176	74	250	0,04
		%	70,40%	29,60%	100,00%	0,98
	3-5 times a week	n	69	30	99	
		%	69,70%	30,30%	100,00%	
Total		n	343	147	490	
		%	70,00%	30,00%	100,00%	

the regularity of menstrual cycles and age, place of residence, major, and BMI of the respondents. Only the year of studies turned out to be the variable that differentiates the surveyed women (p = 0,024). Therefore, our own research showed that the year of study determined the regularity of the menstrual cycle, which occurred more frequently in the group of women in their fourth and fifth years of study than in lower years, especially in the first year.

The analysis of the menstrual cycle regularity depending on selected lifestyle-related factors in the respondents is shown in Table 2.

The obtained results of our own research showed that non-smokers had statistically more regular menstrual cycles (72.9%) than smoking women (57.9%). Women eating breakfast every day had statistically more regular menstrual cycles (73.9%) than women not eating breakfast every day (62.8%). Students who slept 7-8 hours a day had slightly more regular menstrual cycles (71.3%) than the respondents who slept more than 8 hours (69.4%) or 6 hours and less (67.9%). Women who exercised more than 3 times a week had slightly more regular menstrual cycles (70.4%) than those exercising 3-5 times a week

(69.7%) or not at all (69.5%). Students who were rarely stressed had slightly more regular menstrual cycles (73.9%) than the respondents who were stressed quite often (67.1%) or often (70.8%).

The statistical analysis of the examined lifestyle-related variables did not show any statistically significant relationship (p > 0.05) between the regularity of menstrual cycles and physical activity, sleep duration, and stress. Variables that showed statistical significance were smoking (p = 0.006) and eating breakfast every day (p = 0.014). Thus, our own research showed that smoking cigarettes and eating breakfast determined regular menstruation, which occurred more frequently in the group of students who did not smoke and ate breakfast every day.

4. Discussion

Menstrual cycle disorders are one of the most frequent problems reported by young women. In the group of students who were in the time of intense biological and psycho-social changes, the irregularity of the menstrual cycle may be both temporary and chronic, often affecting the quality of life, ability to learn, well-being, and reproductive health (Fernández-Martínez, Onieva-Zafra, Abreu-Sánchez, Fernández-Muñóz, Parra-Fernández, 2020; Shimamoto, Hirano, Wada-Hiraike, Goto, Osuga, 2021). This issue is attracting increasing interest among the medical community, as evidenced by numerous studies analysing the impact of somatic, psychological, and environmental factors on the reproductive system of young women.

This study aimed at assessing the frequency of irregular cycles and identifying selected risk factors in Polish students. The analysis covered socio-demographic variables (age, place of residence, major and year of studies), body mass index (BMI), and elements of lifestyle, such as smoking, eating breakfast, sleep, stress, and physical activity.

The criteria for cycle regularity in the presented study were adopted from Jarząbek-Bielecka et al. (2019) as bleeding occurring at regular intervals of 28 ± 5 days. The results obtained in the group of Polish students showed that the majority (30%) of the students surveyed had irregular menstrual cycles.

A similar result to the one from our own research (29.1%) on the regularity of cycles was achieved by Abreu-Sánchez, Parra-Fernández, Onieva-Zafra, Ramos-Pichardo, Fernández-Martínez, (2020), who examined students in southern Spain. Moreover, Negi et. al. (2018), who, based on research conducted in a group of girls from India, found the cycle irregularity in 28.7% of respondents. Also Zeru, Gebeyaw, Ayele (2021), when analysing cycles in a group of students from the Debre Berhan University in Ethiopia, found that irregular cycles occurred in 32.6% of the respondents. In research conducted by Maekawa et. al. (2023) in a group of 200 students, irregular cycles were found in 24% of the respondents. Moreover, Aber (2018) examined a group of 86 fourth- and fifth-year students of medicine and showed that 20.6% of them had irregular cycles. In contrast, the smallest percentage of women examined (14.2%) had irregular menstruation in studies conducted by Kwak, Kim, and Baek (2019). While the largest percentage of irregular cycles concerned around 48.3% of Taiwanese students of a medical major (students of nursing, obstetrics) compared to other medical majors, this disparity probably results from the nursing curriculum's emphasis on extensive clinical practice compared to medical technology programs (Nguyen, Le, 2024).

The analysis of socio-demographic variables showed that only the year of studies was significantly related to the cycle regularity. Female students in their fourth and fifth years of study were statistically more likely to menstruate regularly compared to first-year students (p = 0.024). This can result from a better adaptation to the student life, greater emotional stability, and a proper stress management strategy. Even though in our own research major did not determine the respondents' cycles, the literature shows that it is justified to analyse this variable. Medical major students are often burdened with intellectual demands, an intensive curriculum and constant exposure to stress – both academic and emotional. Numerous studies show that medical major students, especially nursing and obstetrics, are characterised by more frequent menstruation disorders compared to their peers from other majors (Alhammadi et. al. 2022; Nguyen, Le, 2024; Shantha et. al. 2020).

Our study analysed the age of female students, and even though it was not statistically significant, the literature on the subject indicates that it is one of the major factors affecting the cycle regularity. Mittiku et. al. (2022) , in a study involving 420 students in Ethiopia, showed that women below the age of 20 are 3.88 times more likely to have irregular cycles compared to women aged 25+. The phenomenon may relate to the immaturity of the hormonal axis and greater susceptibility of younger women to environmental and stress factors. Aber (2018) has similar observations, indicating that 85% of cases of irregular menstruation concerned students aged 21-25, with symptoms predominantly beginning before the age of 23. In the context of academic functioning, the cycle irregularity may negatively impact concentration, motivation to learn, and attendance, which directly translates into learning outcomes (Demeke et. al., 2023). Therefore, younger students, during the time of intensive hormonal and environmental changes, are particularly susceptible to the cycle rhythm disruption.

The place or residence due to going to the university may be a significant factor influencing the functioning of the hormonal system of young women, the change in environmental conditions may result in new psycho-social burdens, such as the necessity to adapt to the academic life, change in the circadian rhythm, loss of the family support or an increase in stress level. When examining an international group of students studying in China, Ansong, Arhin, Cai, Xu, Wu (2019) showed that 49.1% of them experienced the menstrual cycle disorders after starting their studies. They indicated that the major risk factors were the language barrier, social isolation, academic stress, as well as changing the diet and circadian rhythm. Similar results were presented by Shantha et.al. (2020) pointing to the impact of environmental changes on the destabilisation of the hypothalamic-pituitary-adrenal axis. However, our study did not show a significant relationship between the place of residence and cycle disorders.

In terms of somatic parameters, the impact of the BMI was analysed. Although there were no statistically relevant relationships, the results are consistent with research that shows that both over-

weight and underweight may disrupt the hormonal axis function. Body fat is metabolically active and affect the production of leptin, oestrogens and SHBG. In women with excessive body weight, more anovulatory cycles are observed, while underweight may lead to secondary hypogonadism and no menstruation (Deborah, Priya, Swamy, 2017; Mittiku et.al. 2022; Singh, Rajoura, Honnakamble, 2019). It is confirmed by research by Deborah et.al. (2017) conducted in India in a group of 399 students that showed that the frequency of irregular cycles was significantly higher in obese people than in people with normal body weight, which was linked by the authors to the excessive body fat and its impact on hormone balance. Similar results were shown by Nguyen and Le (2024), who indicated that, among medical major students, people who were overweight or obese more often experienced irregular cycles than those with the BMI in normal range. It is also worth noting that such chronic hormonal disorders may predispose to gaining body weight. This complex relationship is also confirmed by Korean research (Bae, Park, Kwon, 2018), which showed a statistically significant relationship between the BMI, stress, and smoking and the frequency or irregular menstruation in 4700 women. The impact of being underweight on menstrual disorders is also significant. Singh, et.al. (2019), when analysing a group of 210 teenagers from Delhi, showed that the BMI below 18.5 results in a clearly increased frequency of irregular menstruation, intensification of the PMS symptoms and hypomenorrhoea. Given these observations, measures to bring the BMI to a normal level, both by losing weight and preventing undernourishment, should be an integral part of strategies to prevent menstrual cycle disorders in young women.

Also some lifestyle elements were significant for the cycle regularity. Smoking proved to a significant variable affecting the menstruation rhythm – non-smoking women had significantly more regular periods (p = 0,006). Zafar (2020) confirmed the five-time greater risk of irregular cycles in smoking women. Nicotine disrupts the rhythmic release of GnRH, lowers oestrogen levels and has a negative effect on the endometrium. Data from the Korea National Health and Nutrition Examination Survey

(KNHANES) conducted by Bae, et. al. (2018) in a group of 4788 women in reproductive age indicated a significant relationship between smoking tobacco and increased frequency of irregular periods. This relationship was particularly strong in case of women who simultaneously experienced high levels of stress or were underweight, which suggests a synergic effect of environmental factors on the reproductive system functioning.

Also eating breakfast showed a significant relationship with the cycle regularity (p = 0.014). Students eating breakfast every day has clearly more regular cycles. Fujiwara et. al. (2020) and Negi et al. (2018) showed that skipping breakfast affects hormonal disorders by changes in the secretion of leptin, insulin, and circadian rhythm. Authors emphasised that not only the lack of breakfast, but also the habit of consuming highly processed products rich in saturated fat may influence the progesterone metabolism disruption and increase the risk of PMS symptoms.

Regular physical activity is widely considered one of the overall health foundations, but its impact on the menstrual cycle may be complex and depend on intensity, frequency, and energy balance. In relation to physical activity, our own research showed no significant statistical relationships. However, it is worth emphasising that the literature on the subject indicates that both the lack of activity and an intensive activity (especially in sportswomen) may disrupt the menstrual cycle (Miyamoto, Hanatani, Shibuya, 2021a; Miyamoto, Shibuya, 2024). Moreover, research conducted by Negi et.al. (2018) in a group of 470 girls aged 13-19 in India showed a positive correlation between regular physical activity and a lower risk of painful and irregular periods. Miyamoto, Shibuya (2024) indicated that, in women who actively practice sports, energy deficiencies – especially carbohydrates and vitamin D – play a key role in the pathogenesis of irregular cycles. Whereas Maekawa et. al. (2023), when examining 200 students, did not find a clear correlation between the menstrual condition and the level of physical activity.

Sleep is an essential aspect of the daily life and is closely linked to overall health. It plays an important role in the strengthening of immunolog-

ical functions and guarantees overall well-being. Moreover, melatonin, the main hormone secreted when sleeping, regulates biorhythms. Lower melatonin concentrations correlate with irregular menstruation as well as higher anxiety level and psychological tension in physically active young women (Miyamoto, Shibuya, (2024). In our own research presented, sleep did not show a statistically significant relationship with the cycle regularity, but many papers (Jeon, Baek, 2023; Kim, Nam, Han, Cho, Kim, Eum, Lee, Min, Lee, Han, Park, 2018; Mittiku et. al. 2022; Nam, Han, Lee 2017) explicitly indicate that short or low quality sleep destabilises the HPO axis by disrupting the melatonin, cortisol and GnRH secretion. Sleep shorter than 5-6 hours a day increases the risk of irregular cycles twice. Sleep disorders not only directly affect the hormonal regulation, but also exacerbate other negative factors, such as the mental stress, anxiety, which increase the risk of irregular cycles.

Stress is one of the most commonly indicated factors that disrupt the correct functioning of the hypothalamic-pituitary-ovarian axis, and thus the menstrual cycle regularity. Despite the fact that no statistically significant relationship between stress and irregular cycles was shown in our own study, the contemporary literature involved many studies that conform this relationship. Mittiku et. al. (2022) showed that students experiencing chronic stress had an increased risk of irregular menstruation. It was identified that variables significantly linked to the irregular cycle were: young age, early menarche, and stress, which may lead to the hypothalamic-pituitary-ovarian (HPO) axis deregulation. This mechanism involves increased activation of the hypothalamic-pituitary-adrenal (HPA) axis, which results in increased secretion of cortisol and adrenaline. The hormones disrupt the secretion of GnRH and, secondarily, of FSH and LH, which may lea to inhibition of ovulation, shortening of phases, or secondary amenorrhea. Research by Natt, Khalid, Sial (2018) conducted among students of medicine in Pakistan showed that even short-term stress related to exams was linked to temporary irregular cycles, which is confirmed by the susceptibility of the menstrual

cycle to mental factors. Whereas Kim et. al. (2018), in a big population study involving more than 4400 Koreans, showed that women reporting high levels of mental stress, symptoms of depression or suicidal thoughts had a significantly higher risk of irregular menstruation, especially those with intervals between bleeding exceeding 3 months. The analysis also showed that short sleep worked in synergy with stress, increasing the risk of cycle disorders. Chronic stress impacts not only the neuroendocrine system, but also women's health behaviours, such as poor eating habits, decline in physical activity, increased consumption of substances or sleep pattern disruption. In the study conducted by Jha et. al. (2020) among 200 teenage girls, it was observed that greater stress intensity, insufficient amount of sleep, and low level of mother's education were significantly linked to improper menstruation rhythm and exacerbation of menstrual symptoms.

The results obtained show that even though many factors may affect the menstrual cycle of students, only some of them proved to be statistically significant: year of studies, smoking, and regular breakfast consumption. All other variables, which did not reach the level of significance, remain consistent with the current state of knowledge and may play an indirect or coexisting role. The results emphasise the necessity to implement educational and preventive measures among young women, promoting a healthy lifestyle as part of the menstrual cycle disorders prevention and procreation health promotion.

5. Study limitations

Study limitations may result from the fact that they were based on subjective statements made by participants, which may affect the reliability of the data. Another limitation is the lack of standardized tools for assessing stress, sleep, and physical activity. The use of a deliberately selected sample limits the possibility of generalizing the results to the entire population of Polish students. Therefore, it is recommended that further research be conducted using an improved research tool and carried out among a randomly selected group.

Conclusions

1. Nearly one in three students (30.0%) had irregular menstruation cycles, which may indicate actual and potential health problems. Therefore, it is necessary to identify factors related to irregular menstruation to determine appropriate preventive and remedial strategies.

2. Irregular menstrual cycles significantly more often occurred in respondents who were students of first years of studies, and the remaining socio-demographic variables did not differentiate the respondents.

3. Smoking tobacco and skipping breakfast were strongly associated with irregular menstruation, which highlights the importance of modifiable lifestyle factors in the prevention and promotion of procreation health.

References

Aber, A. (2018). Prevalence of menstrual disturbances among female students of fourth and fifth classes of curative medicine faculty. *IJRDO–Journal of Health Sciences and Nursing, 3*(4), 1-14. https://doi.org/10.53555/hsn.v3i4.1989

Abreu-Sánchez, A., Parra-Fernández, M. L., Onieva-Zafra, M. D., Ramos-Pichardo, J. D., & Fernández-Martínez, E. (2020). Type of dysmenorrhea, menstrual characteristics and symptoms in nursing students in southern Spain. *Healthcare, 8*(3), 302. https://doi.org/10.3390/healthcare8030302

Alhammadi, M. H., Albogmi, A. M., Alzahrani, M. K., Shalabi, B. H., Fatta, F. A., & AlBasri, S. F. (2022). Menstrual cycle irregularity during examination among female medical students at King Abdulaziz University, Jeddah, Saudi Arabia. *BMC Women's Health, 22*(1), 367. https://doi.org/10.1186/s12905-022-01952-2

Ansong, E., Arhin, S. K., Cai, Y., Xu, X., & Wu, X. (2019). Menstrual characteristics, disorders and associated risk factors among female international students in Zhejiang Province, China: A cross-sectional survey. *BMC Women's Health, 19*(1), 35. https://doi.org/10.1186/s12905-019-0730-5

Bae, J., Park, S., & Kwon, J. W. (2018). Factors associated with menstrual cycle irregularity and menopause. *BMC Women's Health, 18*(1), 36. https://doi.org/10.1186/s12905-018-0528-x

Carlson, L. J., & Shaw, N. D. (2019). Development of ovulatory menstrual cycles in adolescent girls. *Journal of Pediatric and Adolescent Gynecology, 32*(3), 249-253. https://doi.org/10.1016/j.jpag.2019.02.119

Deborah, S. G., Priya, S. D., & Swamy, R. C. (2017). Prevalence of menstrual irregularities in correlation with body fat among students of selected colleges in a district of Tamil Nadu, India. *National Journal of Physiology, Pharmacy and Pharmacology, 7*(7), 740-743. https://doi.org/10.5455/njppp.2017.7.0307422032017

Demeke, E., Zeru, A. B., Tesfahun, E., & Mohammed, W. B. (2023). Effect of menstrual irregularity on academic performance of undergraduate students of Debre Berhan University: A comparative cross-sectional study. *PLoS ONE, 18*(1), e0280356. https://doi.org/10.1371/journal.pone.0280356

Drosdzol-Cop, A., & Orszulak, D., & Wilk, K. (2017). Ginekologia dziecięca i dziewczęca – wybrane zagadnienia [Pediatric and adolescent gynecology – selected issues]. In G. H. Bręborowicz (Ed.), *Ginekologia [Gynecology]* (Vol. 2, pp. 254-264). Warszawa: Wydawnictwo Lekarskie PZWL.

Fernández-Martínez, E., Fernández-Villa, T., Amezcua-Prieto, C., Suárez-Varela, M. M., Mateos-Campos, R., Ayán-Pérez, C., … Alguacil, J. (2020). Menstrual problems and lifestyle among Spanish university women. *International Journal of Environmental Research and Public Health, 17*(20), 7425. https://doi.org/10.3390/ijerph17207425

Fernández-Martínez, E., Onieva-Zafra, M. D., Abreu-Sánchez, A., Fernández-Muñoz, J. J., & Parra-Fernández, M. L. (2020). Absenteeism during menstruation among nursing students in Spain. *International Journal of Environmental Research and Public Health, 17*(1), 53. https://doi.org/10.3390/ijerph17010053

Fujiwara, T., Ono, M., Iizuka, T., Sekizuka-Kagami, N., Maida, Y., Adachi, Y., … Yoshikawa, H. (2020). Breakfast skipping in female college students is a potential and preventable predictor of gynecologic disorders at health service centers. *Diagnostics, 10*(7), 476. https://doi.org/10.3390/diagnostics10070476

Jarząbek-Bielecka, G., Sowińska-Przepiera, E., Kędzia, A., & Kędzia, W. (2019). Problem zaburzeń miesiączkowania u dziewcząt [The problem of menstrual disorders in girls]. *Endokrynologia Pediatryczna, 18*(1), 23-28. https://doi.org/10.18544/EP-01.18.01.1713

Jeon, B., & Baek, J. (2023). Menstrual disturbances and its association with sleep disturbances: A systematic review. *BMC Women's Health, 23*(1), 470. https://doi.org/10.1186/s12905-023-02629-0

Jha, N., Bhadoria, A. S., Bahurupi, Y., Gawande, K., Jain, B., Chaturvedi, J., & Kishore, S. (2020). Psychosocial and stress-related risk factors for abnormal menstrual cycle pattern among adolescent girls: A case-control study. *Journal of Education and Health Promotion, 9*, 313. https://doi.org/10.4103/jehp.jehp_419_20

Kim, T., Nam, G. E., Han, B., Cho, S. J., Kim, J., Eum, D. H., … Park, Y. G. (2018). Associations of mental health and sleep duration with menstrual cycle irregularity: A population-based study. *Archives of Women's Mental Health, 21*(6), 619-626. https://doi.org/10.1007/s00737-018-0872-8

Kumar, A., Seshadri, J. G., & Murthy, N. (2018). Correlation of anthropometry and nutritional assessment with menstrual cycle patterns. *Journal of South Asian Federation of Obstetrics and Gynecology, 10*(4), 263-269. https://doi.org/10.5005/jp-journals-10006-1603

Kwak, Y., Kim, Y., & Baek, K. A. (2019). Prevalence of irregular menstruation according to socioeconomic status: A population-based nationwide cross-sectional study. *PLoS ONE, 14*(3), e0214071. https://doi.org/10.1371/journal.pone.0214071

Maekawa, M., Miyamoto, A., Ariyoshi, H., & Miura, K. A. (2023). Survey of the menstrual status of female college students. *Healthcare, 11*(8), 1108. https://doi.org/10.3390/healthcare11081108

Mittiku, Y. M., Mekonen, H., Wogie, G., & Tizazu, M. A., & Wake, G. E. (2022). Menstrual irregularity and its associated factors among college students in Ethiopia, 2021. *Frontiers in Global Women's Health, 3*, 917643. https://doi.org/10.3389/fgwh.2022.917643

Miyamoto, M., Hanatani, Y., & Shibuya, K. (2021). Dietary intake and menstrual cycle changes in international level young athletes. *The Journal of Sports Medicine and Physical Fitness, 61*(6), 851-856. https://doi.org/10.23736/S0022-4707.20.11392-6

Miyamoto, M., & Shibuya, K. (2024). Sleep duration has a limited impact on the prevalence of menstrual irregularities in athletes: A cross-sectional study. *PeerJ, 12*, e16976. https://doi.org/10.7717/peerj.16976

Munro, M. G., Critchley, H. O., Fraser, I. S., et al. (2018). The two FIGO systems for normal and abnormal uterine bleeding symptoms and classification of causes of abnormal uterine bleeding in the reproductive years: 2018 revisions. *International Journal of Gynecology & Obstetrics, 143*, 393-408. https://doi.org/10.1002/ijgo.12666

Nam, G. E., Han, K., & Lee, G. (2017). Association between sleep duration and menstrual cycle irregularity in Korean female adolescents. *Sleep Medicine, 35*, 62-66. https://doi.org/10.1016/j.sleep.2017.04.009

Natt, A. M., Khalid, F., & Sial, S. S. (2018). Relationship between examination stress and menstrual irregularities among medical students of Rawalpindi Medical University. *Journal of Rawalpindi Medical College, 22*(S-1), 44-47. https://doaj.org/article/fd66fc7e21a6467cb054b93fab153cd3

Negi, P., Mishra, A., & Lakhera, P. (2018). Menstrual abnormalities and their association with lifestyle pattern in adolescent girls of Garhwal, India. *Journal of Family Medicine and Primary Care, 7*(4), 804-808. https://doi.org/10.4103/jfmpc.jfmpc_159_17

Nguyen, N. T., & Le, T. T. M. (2024). Factors predicting menstrual irregularity among university students in Ho Chi Minh City, Vietnam: A cross-sectional study. *Belitung Nursing Journal, 10*(4), 424-429. https://doi.org/10.33546/bnj.3303

Pawelczyk, L., & Banaszewska, B. (2020). Cykl miesiączkowy [Menstrual cycle]. In G. H. Bręborowicz (Ed.), *Ginekologia [Gynecology]* (Vol. 2, pp. 17-35). Warszawa: Wydawnictwo Lekarskie PZWL.

Piasecka, K., Łyszczarz, P., Pytka, M., Ślizień-Kuczapska, E., & Kanadys, K. (2021). Analysis of cycle observation sheets in a group of women of reproductive age. *Quarterly Journal Fides et Ratio, 51*(3), 41–51. https://doi.org/10.34766/fetr.v3i51.1115

Podfigurna, A., & Męczekalski, B. (2020). Zaburzenia miesiączkowania [Menstrual disorders]. In G. H. Bręborowicz (Ed.), *Ginekologia [Gynecology]* (Vol. 2, pp. 177-179). Warszawa: Wydawnictwo Lekarskie PZWL.

Rostami Dovom, M., Ramezani Tehrani, F., Djalalinia, S., Cheraghi, L., Behboudi Gandavani, S., & Azizi, F. (2016). Menstrual cycle irregularity and metabolic disorders: A population-based prospective study. *PLoS ONE, 11*(12), e0168402. https://doi.org/10.1371/journal.pone.0168402

Saei Ghare Naz, M., Farahmand, M., Dashti, S., & Ramezani Tehrani, F. (2022). Factors affecting menstrual cycle developmental trajectory in adolescents: A narrative review. *International Journal of Endocrinology and Metabolism, 20*(1), e120438. https://doi.org/10.5812/ijem.120438

Sen, L. C., Annee, I. J., Akter, N., Fatha, F., Mali, S. K., & Debnath, S. (2018). Study on relationship between obesity and menstrual disorders. *Asian Journal of Medical and Biological Research, 4*(3), 259-266. https://doi.org/10.3329/ajmbr.v4i3.38464

Shantha, A., Roselin, V., & Srisanthanakrishnan, V. (2020). Problems associated with menstruation among medical students: A cross-sectional study. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 9*(3), 952-955. https://doi.org/10.18203/2320-1770.ijrcog20200514

Shimamoto, K., Hirano, M., Wada-Hiraike, O., Goto, R., & Osuga, Y. (2021). Examining the association between menstrual symptoms and health-related quality of life among working women in Japan using the EQ-5D. *BMC Women's Health, 21*(1), 325. https://doi.org/10.1186/s12905-021-01462-7

Singh, M., Rajoura, O. P., & Honnakamble, R. A. (2019). Menstrual patterns and problems in association with body mass index among adolescent school girls. *Journal of Family Medicine and Primary Care, 8*(9), 2855-2858. https://doi.org/10.4103/jfmpc.jfmpc_474_19

Zafar, M. (2020). Risk factors associated with irregular menstrual cycle among young women. *Fertility Science and Research, 7*(1), 54. https://doi.org/10.4103/2394-4285.288716

Zeru, A. B., Gebeyaw, E. D., & Ayele, E. T. (2021). Magnitude and associated factors of menstrual irregularity among undergraduate students of Debre Berhan University, Ethiopia. *Reproductive Health, 18*, 101. https://doi.org/10.1186/s12978-021-01156-1