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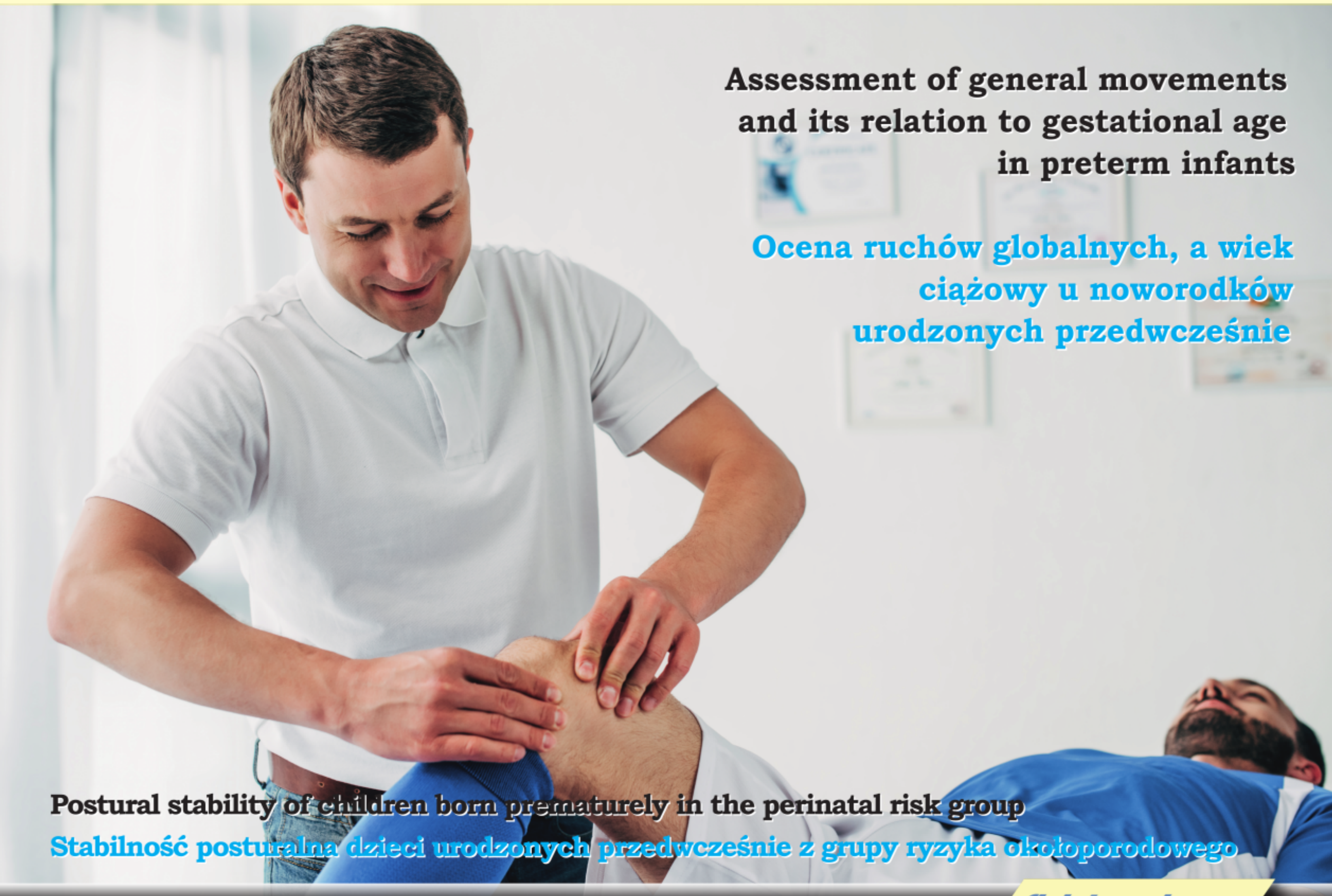
POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 2/2022 (22) DWUMIESIĘCZNIK ISSN 1642-0136



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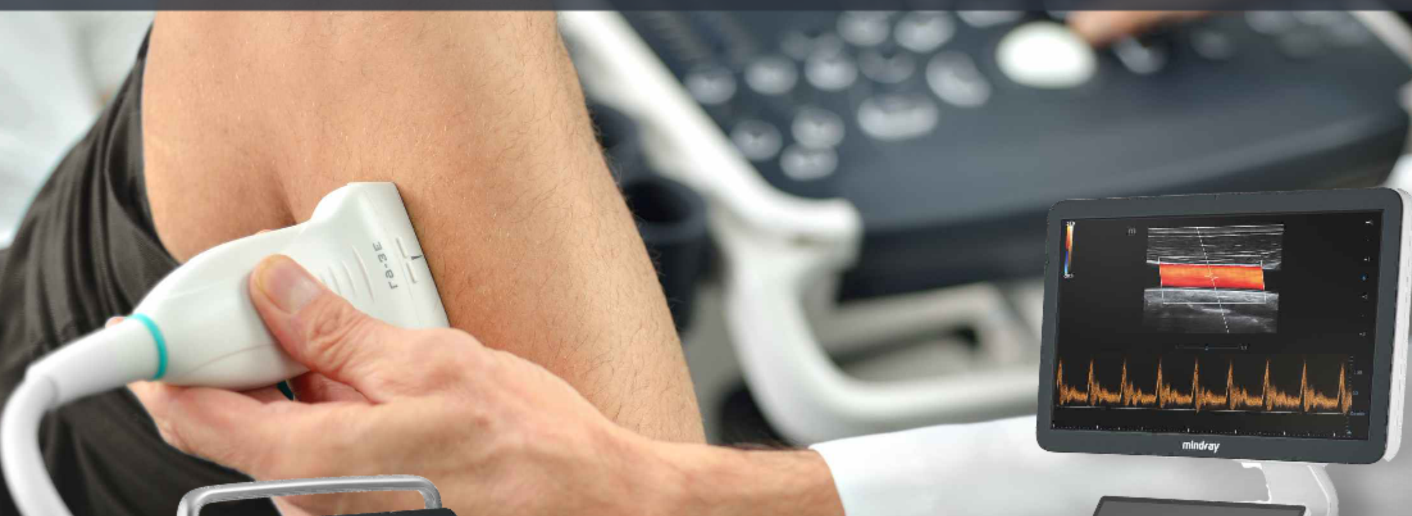

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Evaluation of menstrual cycle irregularities among mature women running recreationally

Ocena nieprawidłowości cyklu miesiączkowego u dojrzałych kobiet uprawiających rekreacyjnie bieganie

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Abstract

A group of 106 mature female recreational runners were studied in the context of their menstrual irregularities due to cycle length, menstrual cycle loss. Influencing factors such as running intensity, years of training, BMI, vitamin D intake were considered. The hormonal fluctuations associated with menstrual irregularities over a woman's lifetime can lead to the initiation of a health cascade and the onset of many serious diseases such as osteoporosis and cardiovascular episodes. Observing the menstrual cycle in women who train to run provides insight into early indicators of more serious health problems that may affect them. Polymenorrhoea, oligomenorrhoea, secondary amenorrhea as well as amenorrhea of less than 3 months can be observed among mature women running recreationally. The irregularities examined may have important implications for women's overall health. Influencing factors: BMI – does not correlate with menstrual interruption and secondary amenorrhea; training intensity - does not correlate with secondary amenorrhea, i.e., no relationship with distance run, number of training days, or length of training per day; years of training – correlates with longer menstrual interruption and secondary amenorrhea; vitamin D – correlates with number of cycles per year.

Key words:

menstrual cycle irregularities, amenorrhea, oligomenorrhoea, BMI, supplementation

Streszczenie

Wstęp: Badaniem objęto grupę 106 dojrzałych kobiet uprawiających bieganie rekreacyjnie w kontekście występujących u nich zaburzeń miesiączkowania ze względu na długość cyklu lub zatrzymanie cyklu miesiączkowego. Uwzględniono czynniki wpływu, takie jak intensywność biegania, lata treningu, BMI, przyjmowanie witaminy D. Wahania hormonalne związane z zaburzeniami miesiączkowania na przestrzeni życia kobiety mogą prowadzić do zapoczątkowania pogorszenia zdrowia i wystąpienia wielu poważnych chorób typu osteoporoza czy epizody kardiologiczne. Obserwacja cyklu menstruacyjnego u kobiet trenujących bieganie daje możliwość wglądu we wczesne indykatory poważniejszych problemów zdrowotnych, które mogą ich dotyczyć. U dojrzałych kobiet uprawiających bieganie rekreacyjnie występują zaburzenia polymenorrhoea, oligomenorrhoea, secondary amenorrhea, jak również niewystępowanie miesiączki poniżej 3 miesięcy. Zbadane zaburzenia mogą mieć istotne znaczenie na całokształt kobiecego zdrowia. Czynniki wpływu: BMI – nie koreluje z przerwami w miesiączce i wtórnym zatrzymaniem cyklu miesiączkowego; intensywność treningu – nie koreluje z wtórnym brakiem miesiączki, to znaczy nie ma związku z przebieganym dystansem, ilością dni treningu oraz długością treningu w ciągu dnia; lata treningu – korelują z dłuższymi przerwami w miesiączce i wtórnym zatrzymaniem cyklu miesiączkowego; witamina D – koreluje z ilością cykli w roku.

Słowa kluczowe:

zaburzenia cyklu miesiączkowego, amenorrhea, oligomenorrhoea, BMI, suplementacja

Introduction

Observation of the menstrual cycle provides insight into early indicators of more serious health problems. Uninterrupted and regularly recurring monthly bleeding is the most obvious clinical sign of a normal menstrual cycle, accompanied by ovulation and indicative of a woman's adequate hormonal levels. It is accepted that the menstrual cycle informs a woman's readiness for reproduction. At the time of the appearance of the first menstrual period, a girl is ≤ 13 years old. This is a body in a period of growth and the appearance of reproductive hormones provides the opportunity for the formation of a healthy female body. Female hormonal influences are partially involved in the functioning of many body systems, including the circulatory system, the skeletal system, the reproductive system, as well as for mental health. Consequently reductions in female hormone levels can potentially have widespread effects due to the presence of sex hormone receptors in numerous tissues throughout the female body [1]. Therefore, the late onset of menarche i.e. first menstruation (primary amenorrhea) in adolescent female athletes has been the subject of many research. Menstrual irregularities in female athletes cover a wide spectrum of irregularities. The most common is amenorrhea, or absence of the menstrual cycle, which can be divided into primary and secondary amenorrhea. Primary amenorrhea, or delayed menarche, and secondary amenorrhea occur in postmenarchal female athletes who have missed three or more consecutive menstrual cycles [2]. Athletic amenorrhea is known to have a hormonal profile similar to menopause, characterized by reduced circulating estrogens [3], which, are involved in bone mineralization, throughout a woman's reproductive period. The skeletal formation, for example, continues until the closure of the bony epiphyses, until about the age of 20. During this time 90-95% of bone mass is formed and the remaining 5% throughout a woman's menstrual period until the onset of menopause. So, hormonal deficiencies during women's reproductive age lead to decreased bone mineral density (BMD) and skeletal strength [1]. The cascade of correlating changes beginning with inadequate hormonal levels, the determinant of which is a disturbed, irregular menstrual cycle, is impressively long, the more irregular the menstrual cycle in young women, the greater the risk of future cardiovascular disease (by up to 50%) [4], it can additionally lead to early cardiovascular episodes [5].

The causes of menstrual irregularities occurring in women training in competitive sports have not been resolved and most studies on menstrual irregularities have focused on highly trained young female athletes in their teenage years. This study is focused on women with higher age category and recreational runners, and aims at investigating whether menstrual disturbances also occur in mature women who do not take part in competitive sports but in recreational running. Menstrual cycle irregularities investigated include: menstrual absence after a period of regular cycles lasting less than 3 months, secondary amenorrhea resulting in chronic absence of ovulation (secondary amenorrhea lasting more than 3 months), cycle length irregularities such as frequent menstrual periods (polymenorrhoea menstrual cycle lasting less than 24 days characterized by a short luteal phase), infrequent menstrual periods (oligomenorrhoea menstrual cycles lasting 35 days or longer). Some of the reasons that predispose women to disordered menstrual cycle include increased physical activity [6], previous menstrual irregularities before starting sports [7, 8, 9], low body mass index (BMI, body mass index) [8], low vitamin D supply, which was also included in this study.

Purpose of the study

The purpose of this study was to evaluate the influence of factors on menstrual irregularities in mature women practicing recreational running.

Specific questions

1. Do significant percentages of menstrual irregularities occur among recreational, mature female runners?

2. Does BMI affect menstrual absence after regular cycles lasting less than 3 months, secondary amenorrhea lasting more than 3 months and menstrual cycle irregularities related to cycle length among recreational, mature female runners?

3. Do years of training affect menstrual absence after regular cycles of less than 3 months, secondary amenorrhea of more than 3 months and menstrual cycle length related irregularities among recreational, mature female runners?

4. Does training intensity affect menstrual abcence after a regular cycle of less than 3 months, secondary amenorrhea of more than 3 months and length related irregularities of the menstrual cycle among recreational, mature female runners?

5. Does vitamin D supplementation affect menstrual absence after regular cycles of less than 3 months, secondary amenorrhea lasting more than 3 months, and menstrual cycle irregularities associated with cycle length among recreational, mature female runners?

Material and methods

The study was conducted using the author's questionnaire, which was completed by 107 women who train running recreationally. The study was conducted in the year 2019.The exclusion factors were: age – women under 21 years old; menopause; women not running. One woman was excluded from the study due to menopause. The anthropometric data of the examined women such as age, height, weight, and BMI are presented in Table 1. 22.4% of the examined women had abnormal BMI, 50% of the women were between 21 and 35 years old and weighed a maximum of 60 kg. A summary of questions regarding the intensity of training is presented in Table 2, almost 50% of the examined women had been running recreationally for up to 4 years at the time of the study, the distances run ranged from 1.5 km to 42 km, while the average run of the examined group was 14.30 km. Typically, the women in the study runned about 4 days per week for approximately 1.5 hours each.
In Tables 1-5, descriptive statistics and raw response

proportions without additional variables are presented. Statistical analyses were performed in IBM SPSS Statistics 27, in which basic descriptive statistics were performed along with frequency analysis of the questions posed to the female subjects. Among the statistical analyses that were used were one-way analysis of variance, regression analysis, Pearson's r correlation analysis, and chi-square tests of sample independence. A threshold of $\alpha = 0.05$ was used as the level of significance. Table 8 presents the results of the analysis of the differences in the different aspects of training that indicated the intensity of training and the commitment of female running trainees according to the presence of secondary amenorrhea. Due to the relatively small samples of women in some variants, an additional Kruskal-Wallis H test was performed to confirm the effects. Regression analysis was performed for the association between training and BMI for secondary amenorrhea. The explanatory variables in the model were years of training, BMI, average distance run, and training intensity constancy, while the dependent variable was secondary amenorrhea occurring at different time intervals, which were arranged in a linear fashion from 0 – no intervals occurred, 3 – 3-6 month intervals occurred.

Table 1. The anthropometric data of the examined women

Quantitative variables	M	Me	SD	Min	Max
Age [years]	36.15	35.00	7.86	21.00	56.00
Height [cm]	165.79	165.00	5.72	152.00	180.00
Weight [kg]	61.49	60.00	9.63	45.00	96.00
Qualitative variables	**Answer category**		**N**		**%**
BMI	Normal		83		77,6%
	Underweight		5		4,7%
	Overweight		19		17,8%

M – mean; Me – median; SD – standard deviation; Min – minimum; Max – maximum; N – sample

Table 1. Questions regarding the intensity of training

Quantitative variables	M	Me	SD	Min	Max
Years of training	5.00	4.00	4.18	1.00	25.00
Minimum distance [km]	6.41	5.00	2.53	1.50	15.00
Maximum distance [km]	22.19	21.00	11.80	5.00	42.00
Average distance	14.30	13.00	6.15	4.00	26.00
Training days per week – minimum	3.24	3.00	1.16	1.00	7.00
Training days per week – maximum	3.93	4.00	1.21	1.00	7.00
Average number of training days	3.58	3.50	1.11	1.00	7.00

Quantitative variables	M	Me	SD	Min	Max
Training hours – minimum	1.02	1.00	0.34	0.50	2.00
Number of hours of training – minimum	1.73	1.50	0.83	0.50	5.00
Average training time	1.38	1.50	0.43	0.50	2.75
Qualitative variables	**Answer category**		**N**		**%**
Training intensity	Fixed		59		55,1%
	Variable		48		44,9%

M – mean; Me – median; SD – standard deviation; Min – minimum; Max – maximum; N – sample

Research findings

Findings on the effect of activity on menstrual irregularities

Length of menstrual cycle Table 3 in the study group there were cycles from 21 to 54 days. Less than 42% of the subjects, declared a full number of cycles per year, which took place every month. Only 35.5% of the subjects showed a completely normal menstrual cycle, which took place 12 months a year at intervals of 25 to 31 days. 10% of the subjects showed lack of regular cycles throughout the year and almost 3% indicated more than 12 cycles. Secondary amenorrhea was declared by less than half of the respondents, with 27.1% indicating amenorrhea of less than three months and 12.1% indicating amenorrhea of three to six months. Questions regarding supplementation Table 5, Dietary supplements were consumed by 63.6%, while vitamin D supplementation was reported by only 15.9% of the women surveyed. It was found in Table 8 that secondary amenorrhea was not related to distance run, number of training days, and length of training per day. However, women with menstrual absence of 3-6 months trained almost twice as long as women with absence of less than 3 months ($p = 0.052$) or never ($p = 0.014$). This indicates that a longer training period is associated with a higher incidence of menstrual delays. These statistically significant differences, in terms of years of training were confirmed by Kruskal-Wallis H test. Additionally, the analysis of Table 7, showed that there is only a positive relationship between years of training and amenorrhea. This means that as the years of training increased, women were more likely to report longer absence of menstrual periods. This effect confirms the analyses performed in Table 6.

Findings on the effect of supplementation on menstrual irregularities

For the supplementation questions of Table 8, supplements were found to be positively associated with the number of cycles per year and negatively associated with the number of menstrual days. This means that women taking supplements significantly have the number of cycles close to twelve per year and fewer cycle days.

Results of correlation analysis between study variables
As noted from the analyses in Table 9, BMI normality does not statistically significantly differentiate with secondary amenorrhea. This means that regardless of weight, delays of less than 3 months or not at all are most common among most women.

Table 3. Length of menstrual cycle

Quantitative variables	M	Me	SD	Min	Max
Average number of days of menstruation	29.25	28.00	5.21	21.00	54.00

Qualitative variables	Answer category	N	
Menstruation	No	1	0,9%
	Yes	106	99,1%
First menstruation – age	9	3	2.8%
	10	4	3.7%
	11	9	8.4%
	12	24	22.4%
	13	33	30.8%
	14	17	15.9%
	15	9	8.4%
	16	5	4.7%
	17	1	0.9%
	18	1	0.9%
Delay of menarche	No delay	73	68,2%
	Delayed	33	30,8%
Length of cycles	Less than 24 days	13	12.1%
	25-31 days	74	69.2%
	More than 31 days	19	17.8%
Number of cycles per year	0	9	8.4%
	2	4	3.7%
	3	4	3.7%
	4	3	2.8%
	5	1	0.9%
	6	6	5.6%
	7	1	0.9%
	8	8	7.5%
	9	7	6.5%
	10	13	12.1%
	11	4	3.7%
	12	44	41.1%
	13	3	2.8%

Qualitative variables	Answer category	N	%
Perfect cycle regularity	Irregular	69	64.5%
	Regular cycles every month at intervals of 25-31 days	38	35.5%

M – mean; Me – median; SD – standard deviation; Min – minimum; Max – maximum; N – sample

Table 4. Questions related to menstrual irregularities

Qualitative variables	Answer category	N	%
Absence of menstruation	No absence	60	56.1%
	Less than 3 months	29	27.1%
	Between 3-6 months	13	12.1%
	More than 6 months	5	4.7%
Number of months of absence	1	9	8,4%
	2	20	18,7%
	4	8	7,5%
	5	3	2,8%
	6	2	1,9%
	7	1	0,9%
	8	1	0,9%
	12	1	0,9%
	16	1	0,9%
	24	1	0,9%

M – mean; Me – median; SD – standard deviation; Min – minimum; Max – maximum; N – sample

Table 5. Questions related to supplementation

Qualitative variables	Answer category	N	%
Supplements	No	39	36.4%
	Yes	68	63.6%
Vitamin D	No	90	84.1%
	Yes	17	15.9%

M – mean; Me – median; SD – standard deviation; Min – minimum; Max – maximum; N – sample

Table 6. Training intensity and menstruation absence

		N	M	SD	F(3.103)	p	η^2	p_{K-W}
Years of training	Never experienced an absence	60	4.43	3.82	4.262	0.007	0.11	0.005
	Less than 3 months	29	4.29	2.67				
	Between 3-6 months	13	7.85	5.80				
	More than 6 months	5	8.60	6.73				
Average distance run	Never experienced an absence	60	14.38	6.30	0.694	0.558	0.02	0.563
	Less than 3 months	29	14.48	5.97				
	Between 3-6 months	13	14.98	6.73				
	More than 6 months	5	10.50	3.76				
Average number of training days	Never experienced an absence	60	3.53	1.15	1.779	0.156	0.05	0.216
	Less than 3 months	29	3.41	0.92				
	Between 3-6 months	13	4.23	1.27				
	More than 6 months	5	3.60	1.08				
Average number of training hours	Never experienced an absence	60	1.31	0.44	1.018	0.388	0.03	0.271
	Less than 3 months	29	1.46	0.46				
	Between 3-6 months	13	1.48	0.39				
	More than 6 months	5	1.40	0.22				

M – mean; SD – standard deviation; N – sample; η^2 – difference effect size; pK-W – significance of Kruskal-Wallis H test

Table 7. Determination of menstrual absence based on training intensity and BMI

Variables included	b	SE	β	t	p	Model
(Fixed)	0.36	0.13		2.87	0.005	
Years of training	0.06	0.02	0.28	2.98	0.004	
Variables excluded						F(1.106) = 8.86; p = 0.004; R^2 = 0.08
BMI			−0.06	−0.59	0.559	
Average distance run			−0.08	−0.83	0.411	
Training intensity constant			0.15	1.59	0.116	

b – unstandardized regression coefficient; SE – standard error; β – standardized regression coefficient; R^2 – explained variance

Table 8. Analysis of differences in different aspects of training

	Days of menstruation	Bleeding days	Number of cycles per year
BMI	−0.08	−0.05	−0.08
Age	−0.16	−0.11	−0.02
Years of training	−0.04	0.08	0.14
Average distance run	−0.10	−0.06	−0.05
Average training days	−0.07	0.00	−0.02
Average training hours	−0.02	−0.20*	0.05
Supplements	−0.18^	0.04	0.20*
Vitamin D	−0.12	−0.05	0.02

*^p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001*

Table 9. BMI and menstruation absence

	Normal		Underweight		Overweight				
	N	%	N	%	N	%	χ^2	df	p
Never experienced an absence	49	59.0%	2	40.0%	9	47.4%	7.18	6	0.304
Less than 3 months	19	22.9%	2	40.0%	8	42.1%			
Between 3-6 months	11	13.3%	0	0.0%	2	10.5%			
More than 6 months	4	4.8%	1	20.0%	0	0.0%			

Discussion

The results obtained show that menstrual irregularities occur not only in women who train in competitive sports but also among women running recreationally.
In the study it was assumed that eumenorrhoea regular menstrual cycles are cycles lasting from 25 to 31 days. And the occurrence of changes in menstrual cycle such as secondary amenorrhoea, oligomenorrhoea and short luteal phase polymenorrhoea were defined as irregular menstruation Table 3 showing the result as high as 64.5% in the studied group of women. The results of our own study showed that only 35.5% of the subjects had a completely normal menstrual cycle which took place 12 months a year at intervals of 25 to 31 days. Keizer et al. as a result of their study concluded that changes in the menstrual cycle can occur after highly demanding training that causes increased secretion of anti-procreative hormones [6]. Sharon et al. conclude, similarly, intense exercise can have a negative effect on female athletes, causing amenorrhea-type menstrual disorders [9]. In our results, training intensity does not correlate with secondary amenorrhea i.e. there is no correlation with distance run, number of training days or training length per day, but the longer a single training session lasted, the fewer days of bleeding were reported. Cokkinades et al. suggest that menstrual irregularity prior to the start of running activity is a more important influencing factor than

training intensity and distance run and is strongly associated with menstrual irregularity that occurs now [7]. All of the women in the study had started running after the onset of menarche, and 30.8% had delayed menarche so current activity had no effect on this. It can be assumed that it is the delayed menarche that influences the appearance of menstrual disorders in the study group, because as many as 27.1% of the subjects experienced menstrual stoppage after a period of regular cycles and secondary amenorrhea lasting from 3 to 6 months occurred in 12.1%. In addition, the results of our study indicate that women who experienced menstrual interruption lasting from 3 to 6 months trained almost twice as long as women whose intervals lasted less than 3 months ($p = 0.052$) or never ($p = 0.014$). This implies that longer training duration is associated with a higher incidence of menstrual dropouts and that menstrual absence are longer in women who have trained running for more years. M K Torstveit, J Sundgot-Borgen [8] report that BMI (body mass index) is related to the occurrence of delay in the onset of menarche as well as the occurrence of secondary amenorrhea in female athletes practicing sports that enforce lean body shape. Among the studied women, as many as 22.4% showed abnormal BMI and underweight concerned 4.7%, normal BMI 77.6% the remaining 17.8% concern those whose BMI indicates overweight. However, our results show that BMI does not statistically significantly differentiate with secondary amenorrhea. This means that irrespective of weight, delays of less than 3 months or not at all are most common among most of the women studied. Bahrami et al. showed that vitamin D supplementation significantly affects menstrual cycle length [10] among the women studied and that vitamin D supplementation diminishes heavy menstruation [10], although this was not statistically significant. In our study, we found that supplements were positively associated with number of cycles per year and negatively associated with number of menstrual days. This means that women who take supplements are significantly more likely to have a number of cycles close to twelve per year and fewer cycle days. In studies, there are precise guidelines for daily vitamin D supplementation for female athletes to protect their bones, which should be 1000-2000 IU of vitamin D3 [11], depending on the season and regular sun exposure so that they can achieve adequate levels of this vitamin of 25-OH-vitamin D > 50 nM [11]. In the studied group, only 15.9% showed vitamin D supplementation, which means that more than 80% of the studied subjects do not have adequate supplementation of vitamin D, which is involved in the process of calcium absorption from food intake. It also means that a significant percentage of the studied women with disturbed menstrual cycles and vitamin D deficiency may be at risk of health problems related to bone formation.

Conclusions

1. Among mature women, training running recreationally there are abnormalities concerning the length of menstrual cycle and the abcence of menstruation after the onset of menstruation less than 3 months as well as secondary amenorrhea which affects the number of regular cycles per year.

2. BMI does not statistically significantly differentiate with menstrual interruption and secondary amenorrhea. This means that regardless of weight, menstrual cycle absence of less than 3 months or not at all are most common among most women.
3. Years of training correlates with longer menstrual absence and secondary amenorrhea. There is only a positive relationship between years of training and menstrual interruption. This means that women were more likely to report longer menstrual periods with increasing years of training.
4. Training intensity does not correlate with secondary amenorrhea i.e. there is no correlation with distance run, number of training days or training length per day, but the longer a single training session lasted the fewer days of bleeding were reported.
5. Vitamin D supplementation correlates with the number of cycles per year. It means that women taking supplements significantly have the number of cycles close to twelve per year and fewer cycle days.

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