ELEMENTS OF EATING PATTERN AND INTENSITY OF DYSMENORRHEA – A CROSS-SECTIONAL STUDY IN A SAMPLE OF POLISH WOMEN

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A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: The importance of dietary pattern for pain relief in women with dysmenorrhea is increasingly discussed in the literature. It is believed that a proper eating pattern may have pain-relieving properties. The development of a perfect diet composition for patients with dysmenorrhea constitutes a major challenge.

Aim of the study: The present study aimed to characterize the eating pattern of Polish women with severe and moderate dysmenorrhea.

Material and methods: The observational cohort study was conducted among 718 women, divided into two subgroups: Group 1 (G1) comprised women suffering from severe pain (N = 355), while Group 2 (G2) involved women with moderate pain (N = 363). Two measurement tools were used in the study: The Visual Analogue Scale (VAS) and an original questionnaire for assessing the frequency of consumption of selected food groups.

Results: The average consumption of vegetables, fruits, dairy products and coffee was significantly lower in G1 than in G2. On the other hand, average consumption of meat, fish and fast food products was significantly higher in G1 than G2. The greatest effect size was observed for the consumption of coffee, as well as fruits and vegetables. Women from G2 had a diet like the lacto-ovo-vegetarian diet, whereas those from G1 followed a Western model diet containing fast food products and foods rich in sugar, salt, and saturated fatty acids.

Conclusions: A proper diet should be promoted among women suffering from dysmenorrhea. The use of a proper diet may be particularly important for the treatments offered to this group of patients.

KEYWORDS: menstrual pain, dietary habit, dysmenorrhea, vegetarian diet, woman health

BACKGROUND

"Dysmenorrhea," or "menstrual pain," constitutes one of the most common complaints reported by women [1]. It is referred to as dysmenorrhea, unspecified in the ICD-10 (N94.6), and there are no uncertain diagnostic criteria [2]. The literature defines the disorder as a severe and oppressive pain in the lower abdomen that may spread to the back and legs [1]. Such pain may occur during menstruation without any pelvic pathology or comorbidities. In this case, the disorder is referred to as primary dysmenorrhea [3]. Some general symptoms may accompany menstrual pain including chills, sweating, headache, nausea, and vomiting. These symptoms may occur before or during menstruation.

Menstrual pain appears for the first time during puberty, shortly after the menarche. Pain persists between 8–72 hours and is most severe during the first or second day of menstruation. Intense recurring pain limits physical activity, deteriorates mental health, as well as affect work productivity and learning processes [1,5,6]. In addition, menstrual pain may also influence public and occupational health [1].

Epidemiological data on dysmenorrhea strata are not coherent [1] and there are numerous factors that try to explain the differences including a subjective assessment of pain intensity [4]; ethnic, sociocultural, or biological factors; as well as different definitions of dysmenorrhea [1]. A multi-variable analysis provided by Grandi et al. [1] stressed that the issue may concern as many as 45 to 93% of women in their reproductive age [7]. According to another study, approximately 40-60% of women may struggle with dysmenorrhea [4].

Common recommendations for relieving severe menstrual pain include nonsteroidal anti-inflammatory drugs (NSAIDs) [8], acupuncture or acupressure, and oral contraception [9]. However, Marjoribanks et al. [10] demonstrated there is insufficient evidence determining which (if any) individual NSAID is safest and most effective for treating dysmenorrhea. Smith et al. also [11] pointed to the fact that there is insufficient evidence demonstrating whether acupuncture or acupressure are effective in treating primary dysmenorrhea. Zahradni et al. [12] reported that combined oral contraceptives are preferential for dysmenorrhea pain relief. At the present time there is no consensus on the most effective and safe treatment of dysmenorrhea [13].

In addition to the above-mentioned therapeutic strategies, scientists are increasingly raising the important and underestimated issue of diet and eating patterns regarding dysmenorrhea [14]. Najafi et al. [15] emphasized that nutrition plays a key role in the prevalence and severity of dysmenorrhea. Additional evidence suggests that diet therapy is effective in reducing pain in female students with primary dysmenorrhea complaints [14]. It is believed that dietary habits might also be of importance [15]. A Western model diet full of processed food rich in simple carbohydrates and saturated fatty acids may lead to increased pain [14,15]. The following factors also appear to influence pain intensity: a high consumption of caffeine [16], salt or high-sodium products, livestock products like meat and offal, and skipping meals [17]. On the other hand, fruits and vegetables and food products rich in fiber may relieve pain [15,18].

Even though the links between dietary factors and menstrual pain are inconclusive, there is a correlation between dietary habits and the prevalence of primary dysmenorrhea. It is also crucial to assess the importance of diet with child-bearing aged women in the follicular phase of the menstrual cycle to determine the role of proper nutrition in menstrual pain relief. Taking the above into consideration, increasing attention is given to the role of diet and eating pattern as a complementary or alternative treatment method for severe menstrual pain [16].

Aim of the study

The present study aimed to characterize the eating pattern of Polish women with severe and moderate dys-

menorrhea. Eating pattern analysis focused particularly on food products that may have a direct impact on the intensity of self-perceived menstrual pain. Such food groups included fruits, vegetables, dairy, meat, fish, fast food products/salty products, sweets, and stimulants (coffee and alcohol).

Material and methods

Study design, setting and duration

The cross-sectional study was performed using computer-assisted web interviewing (CAWI). CAWI is an Internet surveying technique in which the interviewee follows a script provided by the website [19]. The study was carried out from January 2020 to March 2020.

Study population

A total of 949 women with dysmenorrhea took part in the study. The inclusion criteria were not met for 231 women. The analysis included data from a total of 718 surveys. The respondents were divided into two subgroups by pain intensity measured by the VAS [20]. Group 1 (G1) comprised women suffering from severe pain (N = 355), while Group 2 (G2) involved women with moderate pain (N = 363). An average pain level measured by the VAS was significantly higher in G1 compared to G2 (M: 8.04 vs. 5.66, t = 21.443, P<0.001, d = 1.60: 95%CI [1,43; 1,77]).

Inclusion criteria

Inclusion criteria included: 1) dysmenorrhea; 2) age between 18 and 55 years; 3) informed consent.

Exclusion criteria

Women with co-morbidities that may worsen menstrual pain including endometriosis, pelvic inflammatory disease, uterine fibroids, endometrial polyps, adenomyosis, fibromas, polycystic ovary syndrome, cysts, thyroid disease, and anatomic or functional abnormalities (congenital or acquired) were excluded from the study.

Sample size

With a sample size of N = 718 and the number of women between 18 and 50 years of age in Poland (as of 31 December 2018: N = 11 million [21]), the prevalence of menstrual pain was in approximately 45% cases [1] and the error margin was 3.7% (95% confidence level and proportion 0.50).

Ethical Considerations

The non-interventional study design was presented to the Bioethics Committee of the Medical University of Warsaw and was accepted without reservations. Every potential study participant was informed of the aim and course of the study, as well as how data was collected and stored. Study participants provided their consent by electronic questionnaire. Study participants

were also informed that all data and results obtained were anonymous. Approval from the Local Inspector for Personal Data Protection was not necessary due to no personal data were collected.

Measures

Two measurement tools were used in the study: The Visual Analogue Scale (VAS) and an original questionnaire to assess the consumption frequency of selected food groups. The VAS consisted of a straight line with the endpoints defining extreme limits such as "no pain at all" and "pain as bad as it could be". This tool was first used in psychology by Freyd in 1923. The Numerical Rating Scales (NRS) version was used for this study. Patients were asked to circle the number between 0 and 10. Zero represented "no pain at all" whereas 10 represented "the worst pain ever possible". Numerical Rating Scales have been successful as pain-assessment tools in several studies [20].

The original questionnaire for assessing the consumption frequency of selected food groups was developed using literature data [15,18]. This questionnaire consisted of 9 questions. Each of the questions concerned a different food product (vegetables, fruits, dairy, meat, fish, fast food products /salty products, sweets) or stimulant (coffee, alcohol). Each question had the same structure. The respondents were asked a question: "How often do you eat...? Choose the answer that best describes your eating patterns during the past year." (For instance, How often do you eat vegetables?, How often do you eat fruits?, etc.). The following answer options were available and scored accordingly: Never or almost never (0 pt); once a month or less (1 pt); several times a month (2 pt); several times a week (3 pt); every day (4 pt); several times a day (5 pt).

The research tool was supplemented by a list of demographic questions which allowed for a more complete description of the study population. Demographic questions included the following data: place of residence (village/city); education (primary/secondary/higher); menstrual regularity (yes/no); use of hormonal contraception (yes/no); family history of dysmenorrhea – mother, sister, grandmother (yes/no); number of meals (four or less meals per day/more than four meals per day); and smoking (yes/no).

Data collection

The research tool was formatted Google tools and made available to members of a closed user groups on social media focused on dysmenorrhea. The part preceding the questions specified the aim of the study and informed that participation in the study was fully anonymous and voluntary. The project manager was responsible for the distribution and protection of data collected using Computer-Assisted Web Interviews (CAWI method) [19]. The questionnaire was addressed to women struggling with painful menstruation and placed on special forums, blogs, and sites devoted to

dysmenorrhea. Women participating in the study were not financially rewarded for taking part in the study.

Data sharing statement

The data for this study are available on "Zenodo" at https://doi.org/10.5281/zenodo.3757661.

Statistical analysis

Select descriptive statistics were calculated to characterize the data set. The amount and frequency were determined for the categorical variables. The mean (M) and standard deviation (SD) were determined for continuous variables. The variation for categorical variables in both groups was compared using the Chi-square test of independence.

The k-means clustering algorithm was used in the first stage of the analysis to identify groups of women that differ in intensity of pain and frequency when eating certain food products. Distinguishing groups of similar objects within the two clusters was performed. A non-hierarchical clustering algorithm was implemented based on the values calculated for three indices: VAS scores, consumption frequency of selected food groups (vegetables, fruits, dairy, meat, fish, fast food products/salty products, sweets), and stimulants (coffee and alcohol). Two subgroups of women were distinguished: G1 (women suffering from severe pain) and G2 (women suffering from moderate pain).

The second stage of the analysis compared the mean consumption frequency of food products in both groups (G1 vs. G2) with Student's t-test because the sample size was large (N≥30), and the sample mean was normally distributed. This is a result of the Central limit theorem. Therefore, the normal variable distribution test was not performed before using the Student's t-test. The effect size was estimated by calculating Cohen's d coefficient. Values below 0.30 were considered as a "small" effect size, 0.50 corresponded to a "medium" effect size, and >0.50 was a "large" effect size. All calculations were carried out using the STATISTICA package, version 13.3 (Tibco Software Inc., Palo Alto, CA, United States). The threshold of statistical significance was set at 0.05.

Results

Participant characteristics

The mean age of the study group was 22.8 ± 3.32 (min. 18.0, max. 53.0) with a mean BMI value of 22.2 ± 3.33 (min. 16.4, max. 36.6). Both groups of women did not differ in mean BMI value (t = 1.113, P = 0.266) and slightly differed in mean age (M: 22.5 vs. 23.0, t = 2.026, P = 0.043). In addition, women in G1 used oral contraceptives significantly less often compared to women in G2 (13.8 vs. 19.8%, χ² = 4.660, P = 0.031). See Tab. 1 for a list of selected variables of the study population about groups G1 or G2.

Table 1. Comparative analysis of selected women features of the study.

Variable		Total (N = 718)		G1 "severe pain" (N = 355)		G2 "moderate pain" (N = 363)		χ²	P-value*
		N	%	N	%	N	%		
Place of residence	village	90	12.5	47	13.2	43	11.8	0.318	0.573
	city	628	87.5	308	86.8	320	88.2		
Education	primary	9	1.3	5	1.4	4	1.1	0.137	0.934
	secondary	352	49.0	174	49.0	178	49.0		
	higher	357	49.7	176	49.6	181	49.9		
Regular menses	no	73	10.2	38	10.7	35	9.6	4.413	0.110
	usually	279	38.9	150	42.3	129	35.5		
	yes	366	51.0	167	47.0	199	54.8		
Oral contraception	no	597	83.1	306	86.2	291	80.2	4.660	0.031
	yes	121	16.9	49	13.8	72	19.8		
Family history	no	294	40.9	136	38.3	158	43.5	2.020	0.155
	yes	424	59.1	219	61.7	205	56.5		
Number of meals	≤4	579	80.6	284	80.0	295	81.3	0.185	0.667
	>4	139	19.4	71	20.0	68	18.7		
Smoking	no	477	66.4	233	65.6	244	67.2	0.202	0.653
	yes	241	33.6	122	34.4	119	32.8		

* Chi-square independence test

Consumption frequency of food groups and stimulants

The consumption frequency of selected food groups, coffee, and alcohol demonstrated that vegetables, dairy products, fruits and coffee (in descending order) are cho-sen most often. Alcohol and fish (in descending order) are chosen least often. Meat, sweets, and fast food products were consumed with mean frequency. See Tab. 2 for details on consumption frequency of particular food groups.

Differences in the mean consumption frequency for all food groups, except for sweets and alcohol, were sta-

Table 2. Consumption frequency of food groups.

Group of food products	Never or almost never		Once a month or less often		Several times a month		Several times a week		Every day		Several times a day	
	N	%	N	%	N	%	N	%	N	%	N	%
Vegetables	6	0.8	6	0.8	56	7.8	212	29.5	261	36.4	177	24.7
Fruits	3	0.4	17	2.4	96	13.4	303	42.2	204	28.4	95	13.2
Dairy products	26	3.6	17	2.4	54	7.5	265	36.9	266	37.0	90	12.5
Meat	84	11.7	14	1.9	106	14.8	314	43.7	165	23.0	35	4.9
Fish	95	13.2	184	25.6	363	50.6	74	10.3	2	0.3	0	0.0
Fast food	40	5.6	213	29.7	371	51.7	84	11.7	9	1.3	1	0.1
Sweets	20	2.8	95	13.2	259	36.1	262	36.5	64	8.9	18	2.5
Coffee	113	15.7	46	6.4	86	12.0	104	14.5	209	29.1	160	22.3
Alcohol	70	9.7	208	29.0	349	48.6	85	11.8	5	0.7	1	0.1

tistically significant for both groups (Tab. 3). The average consumption of vegetables, fruits, dairy products and coffee was significantly lower in G1 than in G2. On the other hand, average consumption of meat, fish and fast food products was significantly higher in G1 than G2. The greatest effect size was observed for the consumption of coffee, as well as fruits and vegetables. See Fig. 1 for a detailed breakdown of the average consumption of particular food products and stimulants.

DISCUSSION

The present study demonstrated a difference in dietary pattern between women with severe (G1) and moderate pain (G2). It is also one of the few studies that emphasizes the importance of nutrition in menstrual pain relief. The issue discussed here is largely unexplored and the number of reliable studies available is limited [15,17,18]. The present findings may also point to a new field of therapies for menstrual pain relief.

The present findings distinguished patterns of consumption frequency of selected food groups such as vegetables, fruits, dairy, meat, fish, fast food products/salty products, sweets, as well as stimulants including coffee and alcohol. Differences in the mean consumption frequency between groups was found with all food groups except for sweets and alcohol. There was no correlation between alcohol consumption and menstrual pain, which has previously been shown in the literature [3,16].

Table 3. Average consumption of selected food groups.

Product group	G 1 "Severe pain" (N = 355)		G 2 "Moderate pain" (N = 363)		t	P-value*	d (95%CI)
	M	SD	M	SD			
Vegetables	3.52	1.04	3.94	0.90	5.781	<0.001	0.43 (0.28; 0.58)
Fruits	3.15	0.97	3.55	0.94	5.623	<0.001	0.42 (0.27; 0.57)
Dairy products	3.22	1.07	3.56	1.11	4.135	<0.001	0.31 (0.17; 0.46)
Meat	3.01	1.12	2.57	1.40	4.680	<0.001	0.35 (0.20; 0.50)
Fish	1.68	0.83	1.50	0.87	2.927	0.004	0.21 (0.07; 0.36)
Fast food	1.86	0.81	1.62	0.76	4.176	<0.001	0.31 (0.16; 045)
Sweets	2.48	1.00	2.38	1.01	1.431	0.153	-
Coffee	2.23	1.81	3.78	1.23	13.442	<0.001	1.00 (0.85; 1.16)
Alcohol	1.62	0.87	1.69	0.82	1.092	0.275	-

* Student t test.
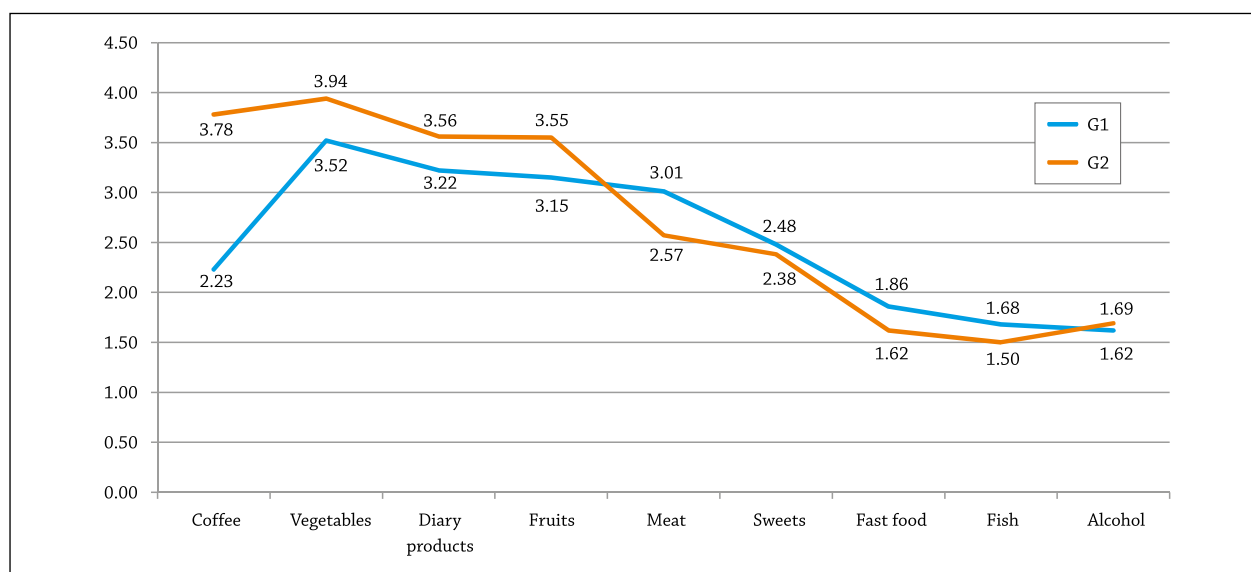
G1 – women suffering from severe menstrual pain; G2 – women suffering from moderate menstrual pain.

Figure 1. Average consumption of selected food groups in two clusters.

G2 (women with moderate menstrual pain) demonstrated significantly higher consumption of vegetables, fruits, dairy and coffee compared to G1. The mean consumption of meat, fish and fast food products was significantly lower compared to G1 (women suffering from severe menstrual pain). These findings suggest these particular food groups play a potential key role in menstrual pain relief among these women. Despite some discrepancies among the published studies, an inverse relationship between menstrual pain and eating vegetables, fruits and dairy products was observed in the literature and in this study [3,14,15]. Bajlan et al. [16] summarized several studies confirming the soothing properties of certain food groups including dairy, vegetables, and fruits with respect to painful menstrual cramps. Additionally, studies showed a positive correlation between menstrual pain and eating sweets, and processed food containing saturated fatty acids. The differences in dairy consumption we found are consistent with Abdul-Razzak et al. [22], where introducing three servings of dairy per day significantly decreased the incidence of dysmenorrhea compared to the group excluding dairy. In addition, there was no report of severe pain in women who consumed four servings of dairy per day. Calcium is the main nutrient in diary productions. Kim et al. showed a small correlation between calcium affecting female sex hormones and regulation of the menstrual cycle [23].

Higher coffee consumption revealed in G2 (moderate pain) compared to women from G1 (severe pain) remains controversial and matches the incoherent findings. Some scientific reports emphasize caffeine either amplifies pain or has no such effect [14-16]. Perhaps a further study should include both a quantitative and qualitative (e.g. FOCUS study or individual interviews) analysis of the caffeine source (not only coffee) in women diets suffering from menstrual pain. It might be crucial to study what drives women to drink coffee and other caffeine-containing products. Tracking eating habits related to coffee consumption would also be of interest.

Meat consumption was another differentiating factor between both groups. Our study suggests that high meat consumption (animal protein in particular) may have a negative impact on the menstrual cycle [24,25]. Differences in daily protein consumption were observed in women regardless of age. Women with menstrual cycle disorders consume a higher amount of total fat, saturated fatty acids, and animal protein compared to plant protein. However, the correlation between protein consumption and menstrual pain was not analyzed; only menstrual regularity was observed [26]. Thus, the study should continue. According to Kartal and Akyuz [14], the quality of meat might be crucial. High quality, low fat meat products may have pain-relieving properties.

Fish proved to be a controversial food group as they were consumed significantly more often by women of G1 (severe menstrual pain). These findings are in contrary to the literature showing that a high source of alpha-linolenic acid in fish produce anti-inflammatory and pain-suppressing effects by dampening the production of inflammatory cytokines and eicosanoids [14,15,18]. Perhaps our results are explained by little fish consumption in Poland. Fish consumption is very low among Polish women, and only take in half the recommended amount [27].

Limitations of the study

The present study is not without limitations. One of the main constraints is the method used for data collection (CAWI), which does not allow for a full control of the study participants. Since, we have introduced verifying questions so persons that do not meet the inclusion criteria were automatically excluded from the ongoing study. Additionally, the original questionnaire assessing the consumption frequency of selected food groups lacks in the qualitative domain. Finally, the lack of plan to conduct a causal longitudinal study is another limitation of this study.

Clinical implications

The present findings suggest that it is crucial to perform a thorough nutritional review for women with menstrual pain instead of just an analysis of consumption of particular food products. Hence, our results may be useful in developing a nutritional procedure for women with dysmenorrhea. The data also supports research to further investigate the eating pattern represented by G2 (similar to the lacto-ovo-vegetarian diet) and its impact on protective and dysmenorrhea-related pain-relieving processes. This is contrary to a Western model diet (food rich in sugar, salt, saturated fatty acids, and fast food products), which may involve an increased risk of menstrual pain [16,17]. The possible health benefits by reducing or completely excluding meat and offal from the diet has been shown [28]. However, there is a need to further investigate and optimize dietary patterns for persons suffering from pain.

It needs to be emphasized that the literature has paid little attention to women eating patterns with respect to their gynecological ailments. As an integral part of the daily routine, diet has a profound impact on body functions and may be crucial in pain occurrence without a clear organic cause, such as with severe menstrual pain. Nutrients from food participate in numerous metabolic pathways related to the regulation of excessive uterine contractions and improved blood flow to the reproductive organs. An adequate supply of these nutrients is critical for maintain health and proper function of the reproductive system. It may also help to relieve pain associated with dysmenorrhea. It is very important to continue research on dietary patterns. Cooperation between members of an interdisciplinary therapeutic team (doctors, physical therapists, and dieticians) is essential for providing top patient care for women with severe menstrual pain. Every effort should be made to thoroughly investigate individual eating patterns not

only to relieve pain and accompanying symptoms, but to also prevent pain occurrence.

Conclusions

The nutrient profile is likely to influence the relief of menstrual pain. A diet compliant with the guidelines of the lacto-ovo-vegetarian diet (high consumption of fruits, vegetables, and dairy products) has protective effects and may relieve pain related to dysmenorrhea. Therefore, this eating pattern should be promoted among women suffering from dysmenorrhea and the use of this diet should be considered as an important measure in treating this group of patients.

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Conflicts of interests:
The authors report that there were no conflicts of interest.

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