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Research article

# Moving online: Implementation of virtual sessions of physical activity and movement training as a therapeutic approach to premenstrual symptoms

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ABSTRACT

*Background:* Aerobic exercise and movement training improve premenstrual syndrome (PMS) symptoms in women. However, the data is still preliminary, and online-based training has not been evaluated yet. Thus, this pilot study aims to assess the workability and usefulness of an online protocol based on aerobic exercise and movement training as an intervention for premenstrual symptoms.

*Methods:* A sample of 30 women from the general population was enrolled in this study, with an average age of 28.27 ± 9.35, and an average BMI of 23.47 ± 3.42 kg/m$^2$. A total of 29 women completed an eight-week online protocol consisting of 30-min aerobic exercises twice a week, as well as a weekly 30-min movement training protocol. A psychological evaluation was conducted at the baseline and after completing the training via the patients' health questionnaire, the body weight image and self-esteem questionnaire, and the premenstrual symptoms screening tool, looking for changes in well-being and specific symptoms related to menses.

*Results:* Significant improvements in PMS ($p = .015$) and mood ($p = .011$) were recorded, with specific mood effects related to PMS symptomatology. The patients provided positive feedback on the protocol, and adherence was optimal.

*Conclusion:* The effectiveness of a combination of aerobic and isometric exercises was confirmed as a valuable tool in improving women's well-being and reducing premenstrual symptomatology, even if the protocol is delivered online, which tends to be more affordable for the participants than in-presence sessions. Future studies might assess the difference between online programs and face-to-face interventions.

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## 1. Introduction

Premenstrual syndrome (PMS) is a common disorder among women of reproductive age. It is a condition characterized by a combination of psychological and physical symptoms that manifest themselves during the luteal phase of the menstrual cycle. These symptoms cease as menstruation occurs or shortly after, when the follicular phase sets in, leading to a symptom-free period [1].

The emotional symptoms of severe PMS include irritability, mood swings, anxiety, and depression. These symptoms are claimed to impact women's quality of life and can affect their social and economic performance [2,3]. Due to its potentially detrimental impact, researchers in the psychiatric community have agreed on including PMS in the Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5) - under the term "premenstrual dysphoric disorder" (PMDD) - in the mood disorders spectrum [4,5]. However, PMS and PMDD do not have the same clinical diagnosis. There is no structured classification for PMS; even though these two disorders have a common manifestation during the premenstrual phase of the menstrual cycle, PMS is considered less severe than PMDD [6]. Indeed, the presence of physical and behavioral symptoms in the premenstrual period, without the affective symptoms, meets the criteria for PMS but cannot lead to the diagnosis of a psychiatric disorder [5]. The essential features of PMDD are mood lability, irritability, dysphoria, and anxiety, which occur during the premenstrual phase of the cycle but go into remission at or shortly after the onset of menstruation; these symptoms interfere with daily activities and interpersonal relationships [4]. PMS is estimated to affect 20%–40% of menstruating women, whereas PMDD is less common, affecting 3%–5% of fertile women [4,7].

Despite the relevant role of PMS and PMDD in the quality of life of women, therapeutic options are not clear; hence, more studies are needed. Several international guidelines recommend exercise as a non-pharmacological treatment for PMS because physical activity improves general fitness, provides an opportunity to socialize, and potentially reduces depressive symptoms, which are all factors that can also help regulate PMS symptoms [8]. Recent research confirms that exercise increases circulating endorphin levels, helps regulate progesterone and estrogen synthesis, reduces adrenal cortisol for a short period, and promotes endogenous anti-inflammatory cytokine production [8]. In addition, physical activity has beneficial effects on multiple abilities. It increases the efficiency of the mind, provides a sense of health and happiness, and provides a positive attitude toward life, thus promoting mental health [9]. Aerobic exercise is defined as any activity that uses large muscle groups, can be maintained continuously, and is rhythmic in nature [10]. It is considered a sufficient way to suppress stress and improve mood; therefore, walking, bicycling, running, and swimming reduce PMS symptoms [9]. Movement and postural training might be defined as a set of lifestyle practices which range from codified exercises for bodily posture (cfr yoga), breath regulation, meditation, and sense-withdrawal [11]. Several studies have demonstrated the clinical positive effects of yoga in different psychiatric disorders, such as anxiety, schizophrenia, and depression, both as adjuvant and as a stand-alone [12,13]. It has also been considered beneficial for women with premenstrual syndrome, showing effects on emotional, physical, and behavioral domains, positively decreasing irritability, insomnia, mental fatigue, depression, and menstrual pain [14].

A recent literature review has synthesized evidence that physical activity and yoga improve well-being in women with PMS symptoms [9], as well as women at all ages, improving balance and cognitive performance [15]. This review underlines the relevance of these interventions for women and calls for new studies due to the scarcity of the evidence in the literature. Moreover, it reports that the positive effects of physical exercise on premenstrual symptoms is not strictly related to the type of exercises administered, showing that enjoyability of the "workout" should be taken into consideration upon designing one. Because of the COVID-19 pandemic, face-to-face meetings for exercise and movement training had to cease, and the interruption seems to have increased the presence of physical and psychological symptoms linked to menstrual function [16]. Thus, this psychological domain, which is so important in terms of a woman's well-being and quality of life, requires the evaluation of new types of interventions that might be more accessible, despite the time limits that characterize women's daily lives. In this regard, the pandemic has actually helped clinicians and researchers to consider different approaches and methods to reach individuals despite social distancing, and the improvements thus achieved may prove extremely helpful in the future [17].

This study aims to evaluate the workability of an online physical intervention for improving women's mental and physical health with premenstrual symptomatology. Our main hypothesis is that including participants in an online physical activity setting can reduce the presence of premenstrual symptoms and improve their mood.

## 2. Methods

### 2.1. Participants

For this pilot evaluation study, a mixed methodology has been used, with both quantitative and qualitative evaluations. A sample of women was enrolled through online public advertisements from February to March 2022. The advertisements aimed to recruit women with generic difficulties during or close to their menses. By advertising in this manner, the study included participants who may not have been aware of PMS or PMDD disorders. The exclusion criteria were as follows: (1) the presence of a major psychiatric diagnosis, such as psychosis, major depression, or eating disorders; (2) the lack of access to an internet connection or any hindrance to participation in the study project; and (3) the presence of a severe medical comorbidity, neurological trauma, or disorder. All the volunteers were screened for exclusion criteria by a trained researcher via a structured interview. The training protocol started in May 2022 and ended at the end of June 2022.

Written consent to participate was provided by each participant before taking part in the study. All participants were volunteers and did not receive any credit or payment. The study protocol was approved by the Padova Ethics Committee (1223/22) and complies with the provisions of the Declaration of Helsinki.

### 2.2. Procedure

After the participant's inclusion in the protocol, specific data were collected to evaluate their level of physical activity, body mass index (BMI), menstrual status, age, and three heart rates (HRs) evaluated at rest in three different moments – in order to calculate the average resting HR. The evaluation of HR for aerobic exercise was performed - as suggested by previous literature - at moderate intensity (about 60–65% maximum HR), which is has been found to be sufficient to improve premenstrual symptomatology [18]. The Karvonen formula was applied to evaluate the maximal HR that each participant was asked to abide by during aerobic exercise in order to standardize the effects of the exercises: *maximum HR = 220 – Age*. The target HR was evaluated with the following formula: *target HR = [(max HR − resting HR) × 65%] + resting HR* [19].

The protocol spanned over eight weeks and included two aerobic sessions that the participants were asked to participate in independently, in addition to one online postural and movement class. The protocol was implemented by trained physical education professionals with specific training in movement training and a trained psychotherapist in mindfulness-based stress-reduction techniques. Each participant was free to decide which type of exercise to perform each week, choosing among walking, jogging, or cycling. The only condition was that the participant remain close to their maximal heart rate, calculated upon enrolment; participants were requested to record it, and to perform two 30-min sessions. Each week, a researcher (GS) assessed each participant's activities, heart frequency, and the level of fruition of the movement and postural class (simultaneously or on a deferred basis). The checks were performed via a videocall and were mainly aimed at monitoring adherence to the weekly aerobic workouts and the adherence to the instruction to perform physical activity during daily hours.

The 30-min movement training classes were administered online via a video call and recorded for later viewing by participants who could not attend live at the scheduled times. The movement-postural protocol developed for this study was in accordance with the standardized Kripalu-based program, used in research evaluation of the benefits of yoga [20]. The program was completely secular and comprised four key elements: physical exercises and postures, breathing exercises, deep relaxation, and meditation techniques. It incorporated an approach to emotion regulation in the instruction to "breathe, relax, feel, watch, and allow". The postures were taught as breath-coordinated movements. Breathing was considered the central tool for nonjudgmental, compassionate self-awareness. Most postures were simple and adaptable for all levels of physical fitness. The 30-min sessions were structured to include a 5-min centering, a 5-min warm-up, 15 min of postures/exercises, and a 5-min closing relaxation. Slow abdominal breathing was a primary focus throughout the duration of all sessions. The layout and structure of the classes are reported in Table 1.

### 2.3. Questionnaires

Before and after the protocol, each participant was asked to fill out three self-report questionnaires. All questionnaires were administered as online surveys. The Patients Health Questionnaire-9 (PHQ-9) includes nine items rated on a 4-point scale from 0 to 3 (0 – never, 3 – nearly every day), which assesses depressive symptoms during the two weeks before the examination. Higher scores are related to depression, with a clinical cut-off of nine points [21]. In this study, Cronbach's $\alpha = 0.794$. The Premenstrual Symptoms Screening Tool (PSST) is a questionnaire containing 19 items scored on a 4-point Likert scale (0 – not at all, 3 – severe). This questionnaire is considered a screening tool for PMS's and PMDD's DSM criteria [22,23]. Higher scores indicate a more severe physical and psychological symptomatology, with two different cut-offs for PMS and PMDD, according to DSM criteria [23]. In this study, Cronbach's $\alpha = 0.946$. The Body Weight Image and Self-Esteem (B-WISE) evaluation is a 12-item questionnaire scored on a 3-point Likert scale (never, sometimes, or all the time), with total scores ranging between 12 and 36. It comprises three different subscales: body image distress (BID), well-being (WB), and weight control (WC). Higher scores indicate a better adjustment. The scoring key varies from item to item, depending on the positive or negative direction of the item [24]. In this study, Cronbach's $\alpha = 0.706$. At the end of the training, the participants were asked to evaluate the overall program. Specific items were rated for pleasantness and enjoyment on a 5-point Likert scale (0 – not at all, 4 – very much), and participants could leave a comment.

### 2.4. Statistics

The Wilcoxon paired signed-rank test was applied to evaluate the difference between the participants' baseline and the end of the protocol due to the non-parametric distribution of the data evaluated with the Shapiro-Wilk test. The effect sizes were calculated with this formula: $r = z/\sqrt{N}$ [25], and the common interpretation has a small effect: 0.10–0.30; moderate effect: 0.30–0.50; large effect: $\geq$0.50. The chi-square test ($\chi 2$) was used to evaluate the change in the prevalence of PMDD and PMS clinical diagnosis. Associations between variables at the baseline were evaluated with Spearman's correlation analyses. The effects of training on premenstrual

**Table 1**
Structure of movement training classes.

| Focus | Description of the exercises |
|---|---|
| Spinal mobility | While sitting on the floor, the participants were asked to execute specific exercises for the mobility of the spine and the neck. |
| Asana exercises | The most intensive part of the class, increasing in difficulty each week. |
| Joint mobility | Specific exercises focused on the increase of the mobility of the upper parts of the body and lumbar area. |
| Muscular stretching | Specific decontraction session aimed at reducing the intensity of the class. |
| Breathing exercises | Supine breathing exercises with a mindfulness approach. |

symptomatology were evaluated with linear regression analysis, with PSST post-training as the dependent variable and PHQ-9 and B-WISE scores at baseline as predictors. The significance level was set at $p < .05$. All the analyses were performed using SPSS Version 25 statistic software package.

The sample size calculation was only an approximation due to the study's exploratory nature. Calculating group differences via *t*-test in our sample (matched pairs, $n = 29$) enables the detection of medium effect sizes $dz = 0.626$, with a power of 0.95. The sensitivity of the regression analysis in our sample found a large effect size with $f^2 = 0.394$, [26]. Both analyses were calculated with G*Power vers. 3.1 [27].

## 3. Results

### 3.1. Baseline evaluation

A total of 35 women responded to the public announcement. After assessment for exclusion criteria, a total sample of 30 women were included in the protocol. Five women were excluded because of a history of psychiatric conditions or because they were currently on psychiatric medications. As for the included women, the mean age was 28.27 ± 9.35 [18–40], and the average BMI was 23.47 ± 3.42 [18.65–28.60] kg/m$^2$. The age of the menarche was 12.20 ± 1.52 years old, and the current average duration of the menses was 5.50 ± 1.53 days. The only medication taken daily by six out of 30 participants (20%) was the estroprogestinic pill. The self-reported evaluation of their physical activity showed that half of the sample (15 out of 30 women) did not do any regular physical exercise, while two participants out of 30 (2%) exercised regularly, and the remaining 13 reported weekly exercise without regularity. Looking at the questionnaires, seven out of 30 participants (23.3%) reached the clinical cut-off of the PSST for a PMDD diagnosis, while 22 out of 30 (73.3%) met the clinical cut-off for a PMS diagnosis.

### 3.2. Evaluation of training effects

Only one woman interrupted the protocol after four weeks due to back pain. The participants did not change their medication throughout the program. As regards participation, the adherence to the two aerobic exercise sessions per week was 95.5%, while adherence to the weekly postural session was 89.7%. All participants participated live in the weekly postural and movement training. Table 2 reports the improvements in the self-report questionnaire after the training. The results were also confirmed, excluding the six participants on estroprogestinic pills. See (Fig. 1).

After the training, a closer look at the PMS and PMDD diagnosis revealed that two out of 29 women (6.9%) had a clinical cut-off for

**Table 2**
Psychological evaluation of the training effects.

| | Baseline | After training | Z | p | r |
|---|---|---|---|---|---|
| PHQ-9 | 9.40 (3.95) | 7.14 (3.52) | −2.550 | .011 | 0.474 |
| PSST | 27.67 (12.71) | 21.52 (10.61) | −2.442 | .015 | 0.453 |
| BID | 12.07 (2.12) | 12.72 (2.09) | −1.416 | .157 | 0.263 |
| WB | 5.57 (1.10) | 5.79 (0.98) | −0.844 | .399 | 0.157 |
| WC | 7.33 (0.92) | 7.48 (0.74) | −0.733 | .464 | 0.136 |

Means and standard deviations. BID: body image distress; WB: well-being; WC: weight control.

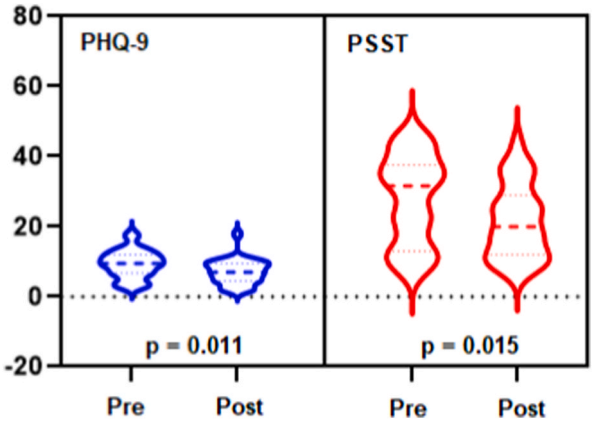


**Fig. 1.** Graphical representation of the psychological constructs evaluated at baseline and after the training program. The patients improved their mood and their premenstrual symptoms. Significant differences are marked with a graph and the p-values are reported. PHQ-9: patient health questionnaire; PSST: premenstrual symptoms screening tool; BID: body image distress; WB: well-being; WC: weight control.

**Table 3**
Spearman's correlation analyses at baseline.

| | Age | BMI | Menarche | BID | WB | WC | PHQ-9 | PSST |
|---|---|---|---|---|---|---|---|---|
| Age | – | | | | | | | |
| BMI | .199 | – | | | | | | |
| Menarche | .065 | −.022 | – | | | | | |
| BID | .041 | −.348 | .073 | – | | | | |
| WB | .002 | .444* | −.183 | −.056 | – | | | |
| WC | −.075 | −.498** | −.045 | .152 | −.340 | – | | |
| PHQ-9 | −.319 | −.031 | .089 | −.591** | −.265 | .248 | – | |
| PSST | −.074 | −.006 | .125 | −.236 | −.217 | .144 | .515** | – |

BID: body image distress; WB: well-being; WC: weight control; PHQ: patient health questionnaire; PSST: premenstrual symptoms screening tool. Rho is reported in the table. *: $p < .05$; **: $p < .01$.

PMDD and 9 out of 29 (31.0%) for PMS. The reduction of the prevalence was not statistically significant for PMDD ($\chi^2(1) = 1.125$, $p = .289$); however, it was significant for PMS ($\chi^2(1) = 4.971$, $p = .026$).

### 3.3. Associations between variables and training effects

As far as associations of variables at the baseline are concerned, PSST correlated only with PHQ-9. We found several correlations that might explain connections between body and wellbeing, like the negative correlation between PHQ-9 and BID. See Table 3 for details.

The exploratory regression analyses found that PSST scores after the training were predicted by PHQ-9 at baseline ($F(1.27) = 6.906$, $p = .014$, $R^2 = 0.204$, $\beta = 0.451$), while no significant relationship emerged with the B-WISE subscales at baseline ($F(3.25) = 0.563$, $p = .644$, $R^2 = 0.063$).

### 3.4. Evaluation

The overall evaluation of the program was positive, receiving 2.86 ± 0.79 out of 4 points. Both pleasantness and usefulness was deemed positive, at respectively 2.66 ± 0.90 and 2.76 ± 0.83 points out of 4). Few optional comments were submitted; they were all constructive:

- *I think it was useful. It helps you to stop and become more aware of your body, to listen to it, especially your breathing, which at the end of the exercises, I found really relaxing.*
- *I will miss doing these exercises so much!*
- *It really helped me a lot. The last time I had my period, I had less pain than usual, and the duration was less than the usual nine days. Thank you very much for letting me participate.*
- *It was a great idea to have the lessons recorded, as not all of us could be there in the evening.*

## 4. Discussion

A significant improvement in mood and PMS symptomatology has been found in women after an eight-week training protocol with movement training classes and aerobic exercise. This data is in line with our main hypothesis concerning the workability of online training to improve the well-being of women, despite the fact that it is limited to physical activity. In a previous retrospective study, online training had been found to be just as effective as face-to-face [28]. However, a multidisciplinary approach was used, so no clear connections between physical activity and improving the symptoms could be shown. Our data have confirmed physical activity's role in reducing premenstrual symptoms without drug intervention and with remote online monitoring.

Our study also shows that mood improvement is a key element in the well-being of women. Regular aerobic exercise and movement training classes are helpful for the improvement of mood and physical health [29,30], with specific effects on PMS symptomatology [31]. These results seem to be linked to the neurobiological effects of endorphins. The endorphins released during exercise might compensate for the reduction experienced by women during the luteal phase [31] and may act via neurotransmitter systems on the modulation of sex hormones or leptin [32,33]. In our protocol, we implemented aerobic, movement, and postural exercises, which may reduce serum IL-6 [34] and increase embodiment cognition, thus leading to psychological well-being [35].

The positive acceptability of the online training and the high level of participation may indicate that it is a useful aid for future online protocols aiming to help with premenstrual symptoms. Indeed, after the pandemic, online interventions have acquired an important role in the medical field [36,37], and physical rehabilitation may benefit from implementing new technological advances. This might act as a key element in improving people's quality of life. The possibility of utilizing recorded movement training classes asynchronously allowed participants to adhere more to the protocol. From this perspective, flexibility may be crucial in intervention programs, and online resources may represent a great opportunity.

No connections were found between premenstrual symptomatology and body image concerns or self-esteem. This aspect is in line with the current literature that reported the biological nature of premenstrual symptomatology [38], but it doesn't agree with the

previous literature that has shown the presence of higher body dissatisfaction in women with PMS [39]. However, this aspect is still under discussion, and the data is merely preliminary. Finally, a specific aspect that might bias our data is the inclusion of the general population in the evaluation and no women with specific PMS diagnoses, which might improve the adherence to the protocol proposed. Thus, more specific studies are needed.

The main limitations of the present study are its small sample size and the absence of a randomized control group. However, our goal was to assess the feasibility of an online training program with aerobic and movement training exercises which has already shown positive effects. Another limit of the study is the use of self-reported data, which – nevertheless - is a limit that all online training and treatments have. Finally, this study had a decent-sized sample and is characterized by the absence of a significant confounder, such as psychoactive medications or the presence of high levels of previous physical activity. Therefore, the results of this pilot study can be considered in full compliance with the aim of the investigation. Future studies are needed, with a larger sample size and a control group, in order to corroborate our data and to allow the assessment of the effects in subgroups (e.g., based on age or sedentary lifestyle).

## 5. Conclusion

According to the results, online training protocols based on aerobic exercise, movement and postural training may provide an effective way to improve mood and alleviate PMS symptoms. In the future, an adequate randomized controlled study could evaluate whether this approach is as effective as in-person training. Based on our results, the implementation of a regular physical activity regimen in women with PMS symptomatology may be a key element in improving their well-being by reducing distress and increasing body awareness.

## Author contribution statement

David Dal Brun; Giulia Spagnolo; Angela Favaro; Elena Tenconi: Conceived and designed the experiments; Performed the experiments; Wrote the paper.

Paolo Meneguzzo: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

## Data availability statement

Data will be made available on request.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e15809.

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