EurAsian Journal of BioSciences
Eurasia J Biosci 14, 5049-5056 (2020)

Response of VO2 max and pain tolerance to aquatic exercise and relaxation training in premenstrual syndrome

Asmaa M. El-Bandrawy [1*], Mohamed Ibrahim Mabrouk [2], Magdy M.A.Shabana [3], Hassan O. Ghareeb [4], Ahmed Assem Abd El Rahim [5]

[1] Department of Physical Therapy for Woman's Health, Faculty of Physical Therapy, Cairo University, Giza, EGYPT
[2] Department of Physical Therapy for internal medicine, Faculty of Physical Therapy, Deraya University, Minia, EGYPT
[3] Department of Musculoskeletal Disorders, Faculty of Physical Therapy, Deraya University, Minia, EGYPT
[4] Department of Gynaecology and Obstetrics, Faculty of Medicine, Cairo University, EGYPT
[5] Department of Physical Therapy for Basic Science, Faculty of Physical Therapy, Deraya University, Minia, EGYPT
*Corresponding author: Asmaa M. El-Bandrawy

Abstract

Background: Premenstrual syndrome (PMS) is a collection of symptoms that many women experience during the one to two weeks before a menstrual period. These symptoms may be physical, psychological and emotional. The fluctuating endogenous hormones estrogen and progesterone are known to possibly affect cardiovascular and respiratory parameters. Exercise can be effective on individuals' pain reduction and improving and maintaining cardiorespiratory fitness.
Purpose: to investigate the effect of aquatic exercises and relaxation training on VO2 max and pain tolerance in premenstrual syndrome.
Methods: A sample of 50 nonathletic girls diagnosed as premenstrual syndrome was selected from the Outpatient Clinic, Faculty of Physical Therapy, Deraya University. Their age was ranged between 18 to 25 years; their BMI was less than 30 kg/m^2. They were allocated randomly to two groups of equal numbers of participants (A and B). The participants in group (A) received aquatic exercises in addition to relaxation exercises three sessions a week for 8 weeks. Group (B) received relaxation exercises three sessions a week for 8 weeks. Assessment of all subjects in both groups was carried out before and after the treatment program through maximum oxygen consumption (VO2max), premenstrual syndrome scale (PMSS), visual analogue scale and blood cortisol level.
Results: Both groups (A and B) showed a significant increase in maximum oxygen consumption (VO2max) and significant reduction in their premenstrual syndrome scale (PMSS), visual analogue scale (VAS) and blood cortisol level after the end of the 8 weeks of the training program. The mean values of VO2max after treatment were (36.73 ± 3.43, 32.04 ± 3.67 ml/kg/min) in both groups A and B, respectively. The mean values of PMSS after treatment were (59.32± 13.48, 99.2 ± 12.96) in both groups A and B, respectively. The mean values of blood cortisol level were (7.50 ± 2.06 mg/dl,11.50 ± 2.20 mg/dl) in both groups A and B, respectively. The mean values of VAS were (2 ± 0.763, 5.04 ± 0.789) in both groups A and B, respectively. However, the participants who received aquatic exercises plus relaxation training (group A), showed a more significant increase in VO2 max and more reduction in the PMSS, VAS and blood cortisol value (P<0.001) after the training program.
Conclusion: 8-weeks regular aquatic exercises in addition to relaxation training are effective in improving VO2 max and decreasing severity of the symptoms of premenstrual syndrome.

Keywords: aquatic exercises, relaxation training, VO2max, premenstrual syndrome, premenstrual syndrome scale, pain

El-Bandrawy AM, Mabrouk MI, Shabana MMA, Ghareeb HO, El Rahim AAA (2020) Response of VO2 max and pain tolerance to aquatic exercise and relaxation training in premenstrual syndrome. Eurasia J Biosci 14: 5049-5056.

INTRODUCTION

Premenstrual syndrome (PMS) is a relatively common psycho-physiological stress induced condition in women in which there is recurrence of physical, emotional and psychological symptoms in a cyclic fashion which occur 7-10 days prior to the start of menstruation (Jasuja et al. 2014).

About 75% to 90 % of the women experience this syndrome before their menstrual period. This syndrome usually starts 6 to 12 days before menstruation and it lasts 2 to 4 days after menstrual bleeding. Various

Received: June 2019
Accepted: April 2020
Printed: October 2020

studies have reported the premenstrual syndrome prevalence rate between 48% and 90% with different intensities (Allais et al., 2012).

Nearly all women who regularly menstruate, experience some symptoms in the luteal phase of the cycle. In some women, these manifestations may be exaggerated and become a cause of misery, family disharmony, absenteeism and suicide (Awrence et al. 2014). PMS is a stress induced disease resulting in psychological and physical symptoms. Common emotional and non-specific symptoms include stress, anxiety, difficulty with sleep, headache, feeling tired, mood swings, and increased emotional sensitivity (Peeke and Frishett, 2002).

Hormonal changes during menstrual cycle tend to affect various parameters of physical fitness. Thermoregulation, minute ventilation and vital parameters such as pulse rate and respiratory rate are affected during different phases of menstrual cycle.(Girija and Veeraiah, 2011). All these parameters affect physical fitness status of the female. Maximum oxygen uptake (VO_2 max) which is a measure of aerobic power refers to the maximum amount of oxygen that can be utilized in 1 min during intense or submaximal exercise. It is considered to be the most reliable indicator of cardiorespiratory efficiency (Bandopadyay, 2008).

Stress induced cortisol secretion has been postulated to produce a cascade of physiological changes that trigger PMS. Consequently, it is only natural that cortisol testing is currently proposed to assess severity degrees (Demers, 1999, Kalman and Grahn, 2004, Koeppen and Bruce, 2008).

Considering the side effects of drug and surgical treatments, non-drug treatments, especially physical activity, have attracted the attention of specialists and women with the disease. It seems that physical activity increase endorphins and reducing adrenal cortisol leads to improvement of symptoms of PMS, increased pain tolerance, decreased anxiety, depression and other problems (Biggs and Demuth, 2011).

Among all forms of physical activity, aquatic activities have the ability to be adapted for all individuals. An aquatic activities can be used to promote physiological and psychological improvements while facilitating independent actions (Omidali, 2015).

Aquatic therapy is any activity performed in water to assist in rehabilitation and recovery from hard training or serious injury. The goals of this therapy are muscle relaxation, improving joint motion and reducing pain (Lori et al., 2009).

The aerobic exercises produce a characteristic “training effect”, in which the cardiovascular adaptations include reduced heart rate at rest and at submaximal workload, increased work capacity and increased maximal oxygen consumption (VO2 max)(Becker,2011).

Various properties of water contribute to therapeutic effects, including the ability to use water for resistance in place of gravity or weights; thermal stability that permits maintenance of near-constant temperature; hydrostatic pressure that supports and stabilizes, and that influences heart and lung function; buoyancy that permits flotation and reduces the effects of gravity; and turbulence and wave propagation that allow gentle manipulation and movement (Dvivedi et al., 2008).

Relaxation therapy techniques are useful in the treatment of many conditions. They are very simple and can be practiced at a beings own comfort along with no side effects. Psycho-neuro-immunology researches recommend relaxation for enhancement of immune power (Padmavathi et al. 2014). The response of relaxation techniques has shown a significant decrease in the abnormally high basal sympathetic activity and a heightened relaxation response (Gençdoğan, 2006).

So, the aim of this study was to investigate the effect of 8-week aquatic exercises and relaxation training on VO2 max and pain tolerance in premenstrual syndrome.

METHODS

The present study is a randomized controlled trial. The study received approval from the Ethics Committee of the Faculty of Physical Therapy, Cairo University.

Fifty Participants who met the following criteria were included in the study: females of ages 18-25 years with regular menstrual cycles diagnosed with PMS, their BMI was ≤30 Kg/m².

Recruitment was done at Outpatient clinic, Faculty of Physical Therapy, Deraya University. All patients have signed an informed consent term.

A diagram of the participants’ retention and randomization throughout the study is shown in **Fig. 1**.

Subjects who had irregular menstrual cycles, past or present diagnosis of psychiatric illness, prescriptive medications as (anti-inflammatory or antispasmodic drugs or any other medications), who smoked, traumatic event in last 6 months were excluded from the study,

Assessment of all subjects in both groups (A& B) was carried out before and after the treatment program throughout VO2 max, Premenstrual Syndrome Scale, Visual analogue scale and blood cortisol level.

Evaluated parameters

VO2 max

A unique approach to VO2 max prediction involves collecting specific non-exercise data from a questionnaire.

Data input to predict VO2 max

1. Sex (Female = 0)
2. BMI
3. Physical activity rating (PA-R). A point value between 0 and 10 representing overall physical activity level for the previous 6 months.

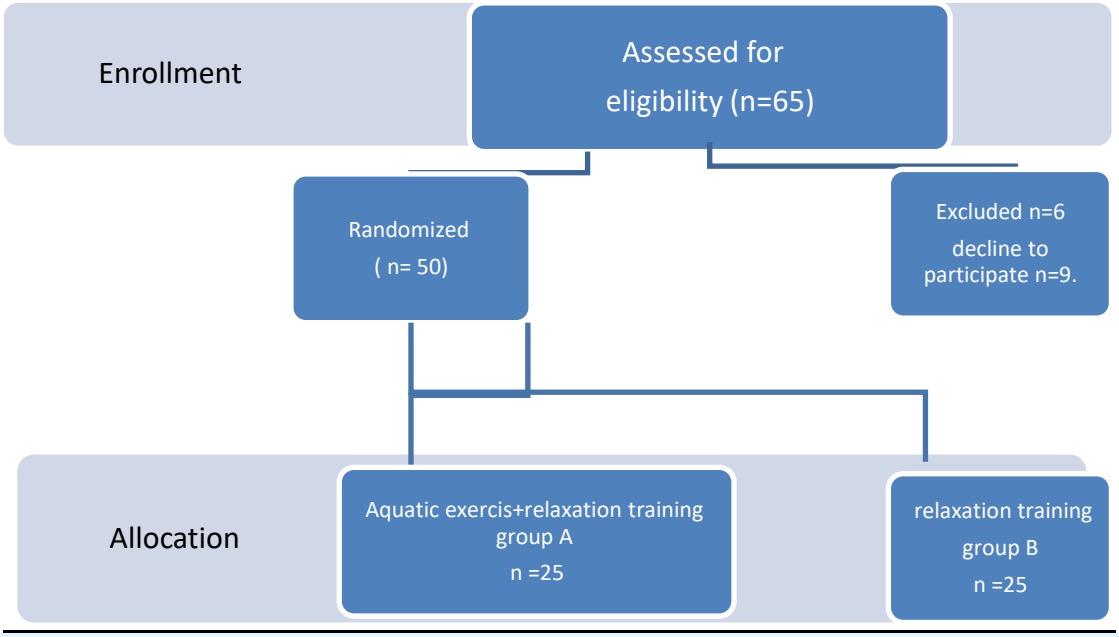

Fig. 1. Consort diagram

4. Perceived functional ability (PFA). Sum of the point values between 0 and 13 for questions about current level of perceived functional ability to maintain a continuous pace to cover a distance of 3 miles without becoming breathless or overly fatigued.

The equation is:

VO2 max (ml/kg/min) =

44.895 + (7.042 × sex) – (0.823 × BMI) + (0.738 × PFA) + (0.688 × PA-R) (George, 1997).

Vo2 max was assessed before and after completion of two menstrual cycles.

Premenstrual syndrome scale (PMSS)

Subjects were asked to fill the premenstrual syndrome scale. This 5-point Likert- type scale consist of 40 items. The measurements on the scale are set according to the following scoring system: the response never was scored as “1”, rarely as “2”, sometimes as “3”, very often as “4” and always as “5” points. It is a reliable and valid instrument for assessing the premenstrual syndrome (Padmavathi, 2020). PMSS was assessed before and after completion of two menstrual cycles.

Blood cortisol level

A blood sample of about 5 cm was drawn in the morning (at 8 o’clock) for all participants in both groups (A and B). Blood samples were drawn before and after treatment for all women by a disposable sterile syringe using venipuncture. PMSS was assessed before and after completion of two menstrual cycles. Blood cortisol level was assessed before and after completion of two menstrual cycles.

Visual analogue scale

The Visual Analogue Scale (VAS) consists of a straight line with the endpoints defining extreme limits such as ‘no pain at all’ and ‘pain as bad as it could be. The patient was asked to mark her pain level on the line between the two endpoints. The distance between ‘no pain at all’ and the mark then defines the subject’s pain intensity (Freyd, 1923). VAS was assessed before and after completion of two menstrual cycles.

Treatment procedures

Participants were randomly assigned into two equal groups (A& B);

Group (A) consisted of 25 subjects who received Aquatic exercises in addition to relaxation training techniques. Group (B) consisted of 25 subjects, who received relaxation training techniques only.

Aquatic exercises for group (A)

At the beginning of the exercises, aquatic exercises technique was educated to the participants out of water. Then, the aquatic exercises were conducted in a chest warm pool (28-30°C) for 30 minutes, three sessions a week for eight weeks. In the first week, aquatic exercises were conducted in shallow part of the pool and in other weeks in the 2-meter deep part. The aquatic exercises included 5 minutes of warming up in form of walking and running in water, 20 minutes of aerobic and strengthening exercises of pelvis, abdominal and thigh muscles (Double-leg Squat, lunge, knee flexion and extension, hip flexion and extension, hip abduction and adduction) developed progressively at intensity sufficient to achieve 50% to 80% of the age predicted maximum heart rate equation (220 – age). Heart rate was measured by a polar pulse watch among the subjects. The exercise session ended by 5 minutes of cooling down with low-intensity and relaxation exercises.

Relaxation exercises for both groups (A&B)

All participants received relaxation exercises in the form of meditation and physical relaxation exercises**.**

Table 1. Subjects' Demographic Characteristics

	Group A (N=25)	Group B (N=25)	t value	P value
Age (years)	20.28±2.99	19.88±3.10	0.755	0.473
BMI (kg/m²)	24.80±7.55	26.43±4.53	0.458	0.633

Data are expressed as mean±SD. NS, P value more than 0.05, not significant. S, P value less than 0.05, significant

Before starting the first treatment session, each patient was instructed briefly about the treatment procedures, which were explained carefully to her to gain her confidence and cooperation. Every participant was asked to be relaxed and restricted clothed was removed.

Meditation

Participants were told to relax in a comfortable sitting position and were engaged in deep breathing with their eyes closed at a comfortable rate. They were told to perform an imagery task, such as that of recalling a pleasant occasion, scenery, objects or concentrating on a pleasant repetitive sequence (e.g. song, prayer) (Bell and Saltikov, 2000). Meditation was applied for 15 minutes three times per week for eight weeks.

Physical relaxation

Step 1 (Tense-relax): Relaxation training is given in the form of tens-relax technique. The subject was asked to flex her fingers and hold for 8–10 s and feel the tension, and then, she relaxed and felt the absence of tension. This was done for all movements (flexion, extension, abduction, and adduction of all the joints). The procedure was done for 20 min three times per week for eight weeks (Dattilo and McKenney, 2011).

Step 2 (Diaphragmatic breathing exercise):

- Every participant was asked to assume a relaxed sitting comfortable position, then she was advised to breathe in slowly and deeply, keeping her shoulders relaxed and upper chest quite. After that, she was asked to take deep inspiration from her nose, make her abdomen like a balloon then expire the air from her mouth with a sigh. This technique was performed as a home routine during stressful conditions for 5 minutes about 5 repetitions for eight weeks and relaxes in between.

RESULTS

Statistical analysis was carried out using SPSS for Windows, version 22 (SPSS Inc., Chicago, Illinois, USA). The P value is the degree of significant. A P value less than or equal to 0.05 was considered to be significant. Comparison between the mean values of different parameters in the two groups was performed using an unpaired t test. Comparison between pretreatment and post-treatment data in the same group was performed using a paired t test.

Maximum O2 consumption (VO2max) (ml/kg/min) before and after treatment for both groups (A and B)

VO2maxbefore and after treatment for both groups (A and B) showed statistically significant increase in both groups (A and B) after treatment (36.73 ± 3.43, 32.04 ± 3.67 ml/kg/min) compared with the corresponding value before treatment (28.54 ± 3.63, 29.66 ± 4.04 ml/kg/min). Comparison between both groups A and B showed a statistically non significant difference in VO2max before treatment (t=1.144, P= 0.264) and a statistically significant difference after treatment in favor of group A (t=1.964, P=.041) as shown in **Table 2**.

Table 2. Mean values for VO2max (ml/kg/min) before and after treatment for both groups (A and B)

	Group A (n= 25)	Group B (n= 25)	t-value	p-value
	$\bar{X}$ ± SD	$\bar{X}$ ± SD		
Before treatment	28.54 ± 3.63	29.66 ± 4.04	1.144	0.264
After treatment	36.73 ± 3.43	32.04 ± 3.67	1.964	0.041
t and P values	20.814 and 0.001	12.914 and 0.001		

Data are expressed as mean±SD. NS, P value more than 0.05, not significant. S, P value less than 0.05, significant.

Table 3. Mean values for Premenstrual Syndrome Scale before and after treatment for both groups (A and B)

	Group A (n= 25)	Group B (n= 25)	t value	p value
Before treatment	135.65± 33.53	131.40± 30.09	0.22	0.80
After treatment	115.51± 30.95	109.33± 30.50	3.10	0. 002
T and p value	20.30 and 0.001	11.37 and 0.012		

Data are expressed as mean±SD. NS, P value more than 0.05, not significant. S, P value less than 0.05, significant

Table 4. Blood cortisol level (mg/dl) for both groups

	Group A	Group B	t-value	p-value
	$\bar{X}$ ± SD	$\bar{X}$ ± SD		
Before treatment	16.75± 1.99	15.30 ± 2.70	0.6	0.21
After treatment	7.50 ± 2.06	11.50 ± 2.20	0.50	0. 002
t and P values	9.50 and 0.001	7.60 and 0.001		

Data are expressed as mean±SD. NS, P value more than 0.05, not significant. S, P value less than 0.05, significant. ↓ ↓ , decrease

Blood cortisol level (mg/dl) for both groups (A and B)

Blood cortisol level (mg/dl) before and after treatment for both groups (A and B) showed statistically significant decreases in both groups (A and B) after treatment (7.50 ± 2.06, 11.50 ± 2.20 mg/dl) compared with the corresponding value before treatment (16.75± 1.99, 15.30 ± 2.70 mg/dl). Comparison between both groups A and B showed a statistically non-significant difference in the blood cortisol level (mg/dl) before the treatment (t=0.6, P=0.21) and a statistically significant difference after the treatment in favor of group A (t=−0. 50, P=0.002) as shown in **Table 4**.

Visual Analogue Scale (VAS) for both groups (A and B)

Visual Analogue Scale (VAS) before and after treatment for both groups (A and B) showed statistically significant decreases in both groups (A and B) after treatment (2 ± 0.763, 5.04 ± 0.789) compared with the corresponding value before treatment (8.8± 0.957, 8.72±

Table 5. Mean values for Visual Analogue Scale (VAS) before and after treatment for both groups (A and B)

	Group A	Group B	t-value	p-value
	$\bar{X}$ ± SD	$\bar{X}$ ± SD		
Before treatment	8.8± 0.957	8.72± 1.061	0.40	0.22
After treatment	2 ± 0.763	5.04 ± 0.789	0.21	0.001
t and P values	25.111 and 0.001	12.568 and 0.001		

Data are expressed as mean±SD. NS, P value more than 0.05, not significant. S, P value less than 0.05, significant

1.061). Comparison between both groups A and B showed a statistically non significant difference in the blood cortisol level (mg/dl) before the treatment (t=0. 40, P=0.22) and a statistically significant difference after the treatment in favor of group A (t=−0. 21, P=0.001) as shown in **Table 5**.

DISCUSSION

Premenstrual syndrome, a common cyclic disorder of young and middle-aged women, is characterized by emotional and physical symptoms that consistently occur during the luteal phase of the menstrual cycle. Women with more severe affective symptoms are classified as having premenstrual dysphoric disorder (Lori et al. 2003).

Most women of reproductive age have one or more emotional or physical symptom in the premenstrual phase of the menstrual cycle. The symptoms are mild, but 5–8% have moderate to severe symptoms that are associated with substantial distress or functional impairment (Frank, 1931).

Maximum oxygen consumption (VO2max) is a fundamental measure of physiologic functional capacity for exercise because oxygen consumption is linearly related to energy expenditure. Oxygen consumption indirectly measures an individual's maximal capacity to do work aerobically. It relies on effective lungs, a capable heart, and a decent vascular framework (Bandopadyay, 2008). The results of this study revealed significant improvement of VO2max in group (A) who received aquatic exercise and relaxation training this may be explained by the resistive effect of water provides exercise loading during limb movements, which enhances muscular tension and increases energy expenditure beyond that achieved with land exercise. Water aerobic exercises improved VO2max better than land aerobic exercises (Arun Prasanna et al. 2017). Jones et al. showed that 12 weeks of moderate/vigorous-intensity aerobic training (55–100%-VO2max, 20–45 min-, 3 times/week) increased the VO2max (from 19.5 - 7.6 to 22.1 - 7.0 mL.kg.min) in women undergoing chemotherapy.

The results of this study revealed significant reduction of pain during aquatic exercise, this may be explained by the role of water in reducing the effects of weight bearing on skeletal joints at rest, thus imposing little strain on low-joint extremities, In aquatic exercise, the body weighs only one-tenth of its actual weight, relieving the normal gravity pressure on both muscles and joints. The pressure of water on the skin and muscles improves venous return. The massage like soothing effect of water on the skin causes special brain responses with calming of the body (Pablo et al. 2011).

Another study found that the relatively mild heat of the water reduces the sensitivity of sensory nerve endings and the muscle tone will diminish when the muscles are warmed by the blood passing through them (Tomas-carus, 2009).

Warm water also helps patients with pain relax and feel more comfortable and reduces their pain sensitivity. The stimulatory effects of warm water promote the relaxation of "tight" spastic muscles, which reduces muscle guarding. During warm water immersion, the sensory inputs are competing with the pain input; as a result, the patient's pain perception is "gated" or blocked out. This reduction in pain is perhaps the most significant advantage of aquatic therapy (Piotrowska and Karbownik, 2007).

The results of this study revealed significant decrease in premenstrual syndrome scale in group (A), this agree with (Khademi et al. 2008) who reported the effect of 8-week swimming, as an aerobic sport, on reduction of physical and psychological pre-menstruation signs. Physical exercise and activity cause an increase in brain efficiency, feeling of happiness and physical and body health and through creating a positive attitude towards life, it can secure the individual's psychological health. Playing sport is more likely to cure the premenstrual syndrome.

The effect of swimming on nervous tension can be explained by the fact that aerobic exercise acutely raises serum progesterone level which affects mode positively and diminishes stress and tension via neurotransmitters (as gamma aminobutyric acid and Serotonin) modulated by sex steroids (Barbosa et al., 2009).

(Guszkowska, 2004) revealed beneficial effects of aerobic exercise as swimming, in both healthy and subjects with emotional disturbances. Low and moderate intensity regular aerobic exercises cause the best improvement in manifestations of PMS (Anxiety, depression, and mood changes) through increasing endorphin and monoamine materials. Exercise helps elevation of body temperature, improves brain circulation and affecting the hypothalamus, pituitary glands and adrenal glands, and changes the physiological reaction to stresses. These finding are similar to a study performed by (Khoshanam et al. 2014) the results showed that, 8 weeks aerobic training significantly decreased psychological and physical symptoms in primary dysmenorrhea.

The acute effect of physical exercise on serum cortisol levels was analyzed by (Rosa et al. 2011) who proved that a significant reduction was observed immediately after the concurrent training protocols. Also,

(Rosa et al. 2010) analyzed the behavior of cortisol levels as an acute response to physical exercise. Results showed a significant reduction in cortisol concentrations after concurrent training.

Stress appears to be one of the accepted causes of premenstrual syndrome. Thus, stress relaxation techniques can be of reasonable value. Regular elicitatio, n of relaxation response results in decreased norepinephrine sensitivity and hence decrease in PMS symptoms like irritability and anxiety (Goodale et al. 1990, Sharma et al. 2013).

The results of this study revealed significant increase in VO2 max in group (B) who was treated by relaxation training, this was supported by (Rastogi et al. 2018) who proved that the Exercise interventions in form of Jacobson's Relaxation technique and aerobic Exercise can bring improvement in maximal oxygen uptake (vo2max) in normal young adult. Diaphragm breathing exercise and feedback breathing exercise could influence maximal oxygen uptake (Yong et al. 2018).

The results of this study revealed significant reduction in the number of symptoms of PMS in the relaxation training group. Furthermore, the results of research by (Mirzaei et al. 2012) indicated that cognitive-behavioural stress management training was effective in reducing psychological problems and premenstrual syndrome symptoms.

The response of relaxation techniques in the patients suffering from PMS has shown a significant decrease in the abnormally high basal sympathetic activity and a heightened relaxation response. Relaxation therapy also improved emotional symptoms and social withdrawal symptoms (Kwan and Onwude, 2009).

Elevated distress levels have been shown to be related to increased cortisol in numerous populations (Gorman et al., 1991). Reductions in cortisol achieved during relaxation training are associated with decreases in distress and anxious mood among HIV-infected men. One such mechanism may be an enhanced sense of mastery or self-efficacy with the relaxation techniques (Antoni et al., 1991, Lutgendorf et al. 1997).

CONCLUSION

8-weeks regular aquatic exercises in addition to relaxation training are effective in improving VO2max and decreasing severity of the symptoms of premenstrual syndrome.

REFERENCES

Allais G, Gabellari IC, Burzio C, Rolando S, De Lorenzo C, Mana O, et al (2012). Premenstrual syndrome and migraine. Neurological Sciences. Springer. 33(1): 111–115.

Antoni M H, Baggett L, Ironson,G,August S, LaPerriere A, Klimas N, Schneiderman N, Fletcher M A(.1991).Cognitive-behavioral stress management intervention buffers distress responses and immunologic changes following notification of HIV-1 seropositivity J Consult Clin Psychol. 59: 906–915.

Arun Prasanna, T Vaithianathan, K & R. Mohana Krishnan, R (2017).Effect of water aerobic exercises and aerobic exercise on Vo2 max parameter among college men students. Int J Pharm Bio Sci. 8 (3), 1115-1118.

Awrence L, Ikeako C, yginus, H, Michael I. (2014).Premenstrual Symptoms. Orient Journal of Medicine. 26 (1-2): 8-14.

Bandopadyay A (2008). Sci. 6:15–20.

Barbosa TM, Marinho DA, Reis VM, Silva AJ, Bragada JA (2009).Physiological assessment of head-out a aquatic exercise in healthy subject. J Sport Sci Med. 8:179–89.

Becker, BE (2011).: Biophysical aspects of hydrotherapy, pp 23-75. Chapter 2 In Becker, BE and Cole, AJ (eds). Comprehensive aquatic therapy, 3rd edition. Washington State University Press.

Bell JA, Saltikov JB. (2000). Mitchell's relaxation technique: Is it effective?. Physiotherapy. 86(9):473-8.

Biggs, WS; Demuth, RH. (2011). Premenstrual syndrome and premenstrual dysphoric disorder". American Family Physician. 84 (8): 918–24.

Dattilo J, McKenney A (2011). Facilitation Techniques in Therapeutic Recreation Second ed. State College: Venture Publishing; 614 p

Demers, LM (1999). Pituitary function. In: dan Edward RA., editor. The Textbook of Clinical Chemistry. 3rd ed. Philadelphia: WB Saunders Company; Carl-A.13.

Dvivedi, J Dvivedi, S Mahajan, KK, Mittal, S Anil Singhal, A (2008).Effect of '61-Points Relaxation Technique' on Stress Parameters. Indian J Physiol Pharmacol. 52(1):69-76.

Frank R. (1931).The hormonal causes of premenstrual tension. Arch Neurol Psychiatry. 26:1053–57.

Freyd M (1923).The graphic rating scale. J Educ Psychol. 43:83–102.

Gençdoğan, B (2006).remenstruel sendrom için yeni bir ölçek. Türkiye'de Psikiyatri. 8(2):81 87.

George JD (1997). Non-exercise VO2 max estimation for physically active college students. Med Sci Sports Exerc. 29: 415-421.

Girija B, Veeraiah S. (2011). Physiol Pharmacol. 55:165–9.

Goodale IL, Domar AD, Benson H (1990). Alleviation of premenstrual syndrome symptoms with the relaxation response. Obstet Gynecol. 75 (4): 649–55.

Gorman J, Kertzner R, Cooper T, Goetz R, Lagomasino I, Novacenko H, Williams J,Stein Y, Mayeux R, & Ernhart A (1991).Glucocorticoid level and neuropsychiatric symptoms in homosexual men with HIV infection. Am. J. Psychiatry.; 148: 41–45.

Guszkowska M (2004).Effects of exercise on anxiety, depression and mood. Psychiatr Pol. 38(4):611–620.

Jasuja V, Purohit, G, Mendpara,S, Palan B.M (2014).Psychological Symptoms in Patients of Premenstrual Syndrome using Progressive Muscular Relaxation Technique. Journal of Clinical and Diagnostic Research; 8(4):BC01-BC03.

Jones, L.W.; Fels, D.R.;West,M.; Allen, J.D.; Broadwater, G.; Barry,W.T.;Wilke, L.G.;Masko, E.; Douglas, P.S.;Dash, R.C.; et al. (2013),Modulation of Circulating Angiogenic Factors and Tumor Biology by Aerobic Training in Breast Cancer Patients Receiving Neoadjuvant Chemotherapy. Cancer Prev. Res. 6, 925–937.

Kalman BA, Grahn RE. (2004). Education. 2(2):A41–A49.

Khademi A, Tabatabaeefar L, Akbari E, Alleyassin A, Ziaee V, Asghari-Roodsari A (2008). Comparison of prevalence of Premenstrual syndrome in swimmer and non- swimmer students. Acta Medica Iranica. 46(4):307–311

Khoshanam E, Nikseresht A, Dehghanzadeh N (2014).The Effect of 8 Weeks of Aerobic Exercise on Primary Dysmenorrhoea. European Journal of Experimental Biology. 4(1); 380-382.

Koeppen, Bruce M.; Stanton, Bruce A. Berne & Levy physiology (6th ed.). Elsevier, 2008: p. 790.

Kwan, I, Onwude, J (2009). Women's Health- Premenstrual syndrome. Clinical Evidence © BMJ Publishing Group Ltd.

Lori M. Dickerson, Pharm.D., Pamela J. Mazyck, Pharm.D., & Melissa H. HUNTER, M.D.,(2003).Medical University of South Carolina, Charleston, South Carolina,Am Fam Physician. 67(8):1743-1752.

Lori T. Brody, Paula R and Geigle (2009) Aquatic Exercise for Rehabilitation and Training. United states of America: Human Kinetics.

Lutgendorf S K, Antoni M H, Ironson G, Klimas N, Kumar M, Starr K, McCabe P,Cleven K, Fletcher M A, Schneiderman N. (1979).Cognitive-behavioral stress management decreases dysphoric mood and herpes simplex virus-Type 2 antibody titers in symptomatic HIV seropositive gay men. J. Consult. Clin. Psychol.; 65: 23–31.

Mirzaei F, Neshatdoost H, Kalantari M, Mahani KN, Student SJ, Student TM (2012).The Effect of Cognitive-Behavioral Stress Management on Anxiety and Somatic Symptoms of Women with Premenstrual Syndrome. J Knowledege Res Appl Psychol. 12 :61–71.

Ms. P. Padmavathi1, Dr. Raja Sankar, Dr. N. Kokilavani3, K. Dhanapal4, B. Ashok(2014;) : Validity and Reliability Study of Premenstrual Syndrome Scale (PMSS). International Journal of Advances in Nursing Management. 2(1):4-10.

Omidali F. (2015).he effect of Pilates exercise and consuming fennel on pre-menstrual syndrome symptoms in non-athletic girls. Complement Med J. 2 (15)1203–1213.

Pablo Cervell E, Cocca A, Viciana J(2011).Effect of an aerobic training program as complementary therapy in patients with moderate depression. Percept Mot Skills, 112(3):761–769.

Padmavathi, P, Raja Sankar, N. Kokilavani, K. Dhanapal, B. (2020).Ashok.Validity and Reliability Study of Premenstrual Syndrome Scale (PMSS). International journal of advances in nursing management. 8(3).

Peeke PM,(2002). Frishett S. The role of complementary and alternative therapies in women's mental health. Prim Care; 29(1):183-197.

Piotrowska CE, Karbownik, K J. : The influence of shallow and deep water exercise on the specific morpho physiological indicators and level of physical fitness. Medicina Sportiva, 2007; 11(1):11-16.

Rastogi,A Lamba, D and Ritambhara K. (2018).Efficacy Of Jacobson's Relaxation Technique In Improving Aerobic Fitness (Vo2max) In Young Adults - An Experimental Study. International Journal of Current Research. 10(5):69859-69867.

Rosa G, Dantas EHM, Mello DB. (2011).The response of serum leptin, cortisol and zinc concentrations to concurrent training. Hormones; 10(3):216-22.

Rosa G, Mello DBd, Biehl C, Dantas E. (2010).Níveis de cortisol em adultos com sobrepeso submetidos a treinamento concorrente. Brazilian Journal of Sports and Exercise Research,; 1(1):11-5.

Sharma B, Misra R, Singh K, Sharma R,(2013). Archana null. Comparative study of the effect of anuloma-viloma (pranayama) and yogic asanas in premenstrual syndrome. Indian J Physiol Pharmacol. 57 (4): 384–9.

Tomas-carus PH. (2009).Eight months of physical training in warm water improves physical and mental health in women with fibromyalgia. Rehabil Med. 40: 248–52.

Yong,M, Lee, Y, Lee, H,(2018).Effects of breathing exercises on resting metabolic rate and maximal oxygen uptake. J. Phys. Ther. Sci. 30: 1173–1175.