

## Pilates Exercises Influence on the Serotonin Hormone, Some Physical Variables and the Depression Degree in Battered Women

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**Abstract:** The purpose of the study is to identify the Pilates exercises program impact on the serotonin hormone and some physical variables which represented in the (legs and back muscles strength, muscular endurance and flexibility) and the depression degree for battered women. 10 Ladies of the resident in the host and guide institute of the battered women of Minia governorate were subjected to implement the Pilates exercises program for 12 weeks. The researchers used experimental method by pre and post measurement design to one group, using Beck Aaron measure to measure depression degree and statistical data indicated that there are statistically significant differences between pre and post measurements favoring post measurements in the variables under consideration and for the telemetric and the presence of correlation inverse between the serotonin hormone and the depression degree, it was extracted that Pilates exercise have a positive impact on reduction of the depression degree, improvement in muscle strength, muscular endurance and flexibility.

**Key words:** Pilates exercises % Serotonin hormone % Depression % Battered women

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### INTRODUCTION

Pilates is an excellent way to trim down your body and strengthen core muscles without bulking up. This style of exercise will teach you how to control your body's movements and increase your flexibility and grace.

Joseph Pilates originally considered this to be a body/mind/spirit approach to movement founded on the integrative effect of six principles: centering, concentration, control, precision, breath and flow. These six principles are the foundation of the Pilates approach to exercise. Their application to the Pilates method of exercise is part of what makes it unique in the fitness world.

King [1] indicates that Pilates exercises are a structured exercise for each large and small muscle groups and aims to find the moderate in the natural shape of the body, taking into account all the factors involved in obtaining a healthy body.

Pilates is an exercise system that teaches body awareness, good posture and balance. It not only helps to shape your body by helping you to lose fat and gain muscle, but as well it improves your overall flexibility, agility and economy of motion. Pilates has even been

proven to help with a variety of health conditions, including back pain. Results of previous studies [2-4] indicated that Pilates exercises have a positive effect on back muscle strength and also relieving back pain.

Pilates exercise does a lot of things to our body. Unlike other exercises which can cause stress and injuries, Pilates can keep you safe from unwanted harm. It can help to develop a healthy body by promoting blood to run deeply into your whole system, Instead of causing stress. Practice these exercises increases the body power level and gives the ability to relieve the body tension and stress and lower back pain and helps as well as develop flexibility and helps to get strong muscles in addition to improving the breathing and circulation process, can be exercise safely every day without the presence of any excess pressure on the muscles and joints it also can be practiced in all times to help calm and gives a sense of balance and rejuvenation [5].

Pilates exercise can build strength without bulking up and contribute to weight loss which is very important to many people, especially women who want to work out and shape their body. A study of Jago *et al.* [6] concluded that the girls who enjoyed Pilates and participation for 4 weeks lowered BMI percentile. Pilates holds promise as a

means of reducing obesity. Abdul Fattah [7] said that serotonin is a compound (5-Hydroxy Tryptophan) that has the symbol (5-HT), found in the mucous membranes of the digestive system and by about 95% in platelets which is a neurotransmitter in the transfer of nerve signals to the brain, plays an important role in mood regulation, attention property, sexual desire, to help digestion in the stomach, the organization of the circulatory system, blood clotting and wound healing. Serotonin acts as a neurotransmitter, a type of chemical that helps relay signals from one area of the brain to another. Although serotonin is manufactured in the brain, where it performs its primary functions, some 90% of our serotonin supply is found in the digestive tract and in blood platelets.

There is agreement between some researchers [8-10] that serotonin hormone is topical hormone and found in mucous membranes of the digestive system and in about 95% of the platelets in the central nervous system and considered as one of the neurotransmitters and has great significance in the mood of the individual and increase the process of attention, a hormone that stimulates the body League, by contraction the blood vessels and increases the breathing rate and blood pressure and alerts the smooth muscles and nerve endings in the skin and links between the reflexes of the respiratory system and it may be a cause in the case of general fatigue during exercise and during exercise concurrent, as excessive training leads to increasing its level in the peripheral nerves and it alerts the sensory nerves of the sympathetic system, causing increased heart rate, which is one of the signs of over-training.

Serotonin has been found to have multiple functionalities and some major functions controlled by serotonin include sleep, temperature regulation, sexual behavior, appetite, learning, memory, endocrinal functions, anxiety, depression, moods, muscular functions as well as cardiovascular functions.

Meltzer and Lowy [11] indicates that serotonin (5-HT) hypothesis of major depression has been formulated in three distinct ways, One version of this hypothesis is that a deficit in serotonergic activity is a proximate cause of depression, a second theory is that a deficit in serotonergic activity is important as a vulnerability factor in major depression, a third hypothesis, now of historical interest only, attributed increased vulnerability to major depression to enhanced serotonergic activity.

Depression is one of the most current psychical disorders, disorder of the brain and body Frequent symptoms of depression include fatigue and a sense of being "slowed down" physically and mentally, affects a

person's family and personal relationships, sleeping and eating habits and general health . Women are at a higher risk for depression than men, One of four women and one of 10 men can expect to develop it during their lifetime. Many women have a reason to be depressed. They live in poverty, are abused, or were abused as young girls. This early life abuse can set them up for depression as an adult. Several studies which on major depression disorder were accomplished in different countries show that rate of its prevalence in women is twice as much as men [12].

The issue of violence against women is a global issue due to its spread across the different countries where its not associated with degree of social progress or failure and are not related to economic or cultural factors its members; a woman may be a victim to violence in various communities, as well as all classes; and that violence against women not limited to physical violence, but also extends to other dimensions which may be more serious, such as psychological abuse, moral or institutional.

Exercise also provides a diversion from negative, obsessive thoughts and feelings. A direct result of exercise make Ability to eat more freely without worries about gaining weight, also increases pleasure, satisfaction and a sense of self-control. It also suggested that the practice of physical activity is a tool for psychological treatment, such as depression and anxiety, it modifies mood and represents a kind of time-out, or a break for a short period of the daily burden leads to reducing stress and anxiety and tension and improve the psychological aspects [13].

Badran [14] indicates to that the exercise has benefits both physical and psychological, physiological, it strengthens muscles, increases joint flexibility and works to stimulate blood circulation, reduce stress and attribute it to that when you exercise it improves the functional status of your league and respiratory, by helping lungs inhale air and increase the amount of oxygen to the brain and muscles, as well as to strengthen the muscles that leads to avoid feeling pain and muscle spasm, while reducing the degree of feeling stress and increases the ability to meet the requirements of life. Babyak *et al.* [15] experimental study have shown that an exercise program appears to be at least as effective in reducing clinical depression as more conventional treatment regimens like antidepressant medication.

Serotonin is a key to our feeling of happiness and very important for our emotions because it helps defending against both anxiety and depression. It is now clearly evident that depression is a direct result of a dip or decrease in the serotonin level in the brain.

This being the case, several pharmacological substitutes are now being introduced to help to treat depression, especially by increasing the levels of serotonin in the brain. While thinking about depression and exercise it makes sense that muscle activity may help discharge old feelings associated with negative events. 80% of depression sufferers cannot sleep well, exercise can regulate sleep patterns.

In addition to the numerous treatments for depression, exercise has become an appealing new alternative to alter on mood. Many recent studies have been published supporting the belief that exercise has been proven to be effective in improving depression and in some cases has been able to prevent it all together. Research studies also indicate that the best way to increase serotonin levels is to exercise regularly, especially on a daily basis. This is found to be one of the simplest and easiest ways to increase the production of serotonin. Karter [16] emphasizes that the pilates exercise lead to an improvement in the work of the lungs, heart and blood vessels with increased strength and muscular endurance, muscle stretching and balance as well as it works to moderate mood, reduces the tension, depression and stress in all aspects of life.

## **MATERIALS AND METHODS**

The researchers used the experimental method by pre and post-measurement design of one group. 15 ladies which follow resident status to host and guide institute of the battered women, Minia governorate and the Ministry of Social Solidarity were selected. Three women were excluded as a result of suffering from depression and according to the measure of Beck Aaron, so the sample became of 12 ladies, then two women were excluded from statistical transactions due to not completing the search experience for the end to make the final research sample only 10 women, aged 32.20-3.05 years, 158.40-2.27 cm tall, 74.20-1.75 kg weight and their degree of depression was 19:30-0.95 degrees.

The researchers insisted the sample to be of women living in the institute and not to exercise to any physical activity and safety of any chronic diseases and an elevated degree of depression on average according to Beck Aaron measure, as the total score of a measure is 48 degrees, the degree of very severe depression is 37 degrees or more, the degree of depression is from 24-36 degrees, the degree of average depression records from 16 to 23 degrees, the degree of simple depression from 10-15 degrees and the degree of no depression is from 0-9 degrees.

The researchers designed Pilates exercise program and presented to the group of experts in (coaching, gymnastic and sports physiology) to express their opinions on the program content and its appropriateness for the research sample and to achieve its aim.

The test was conducted on Thursday 2/4 and Saturday 4 / 4 / 2009 on a sample of five women of the women who attend the center are enrolled, but are not residents in the center in order to check on understanding of the sample axes measure the degree of depression and implementation one of unit of a training module and exercise program as well as check on the validity of the tools and devices used in the tests.

Pre measurements were conducted by researchers before the implementation of the program, a sample of blood from the sample amount (5 ml) was taken by a physician in the institute was kept in the tube after the addition of heparin to prevent blood clotting and was sent to the laboratory for analysis and measurement of heart rate was by stethoscope, device Sphygmomanometer measured blood pressure, Beck Aaron scale was applied to measure the degree of depression and that on Monday 06/04/2009. The muscular endurance, with the abdominal muscles, flexibility and strength of back muscles and legs were measured using a dynamometer on Tuesday 7 / 4 / 2009. Post measurements were conducted under the same procedures for pre-measurements after the implementation of the program on Saturday and Sunday 4, 5 / 7 / 2009.

**Instrumentation:** Pilates exercises are designed to develop muscle strength and muscular endurance, flexibility and focus on the major body muscle such as legs, back and abdomen muscles based on body weight without causing stress or pain of the muscles and joints in addition to mental focus during the performance since all the exercises performed individually and accompanied by soft music which makes this exercise leads to excitement and feeling of happiness during the performance and mild mood and relieve tension and depression and the removal of different pressures.

Pilates exercises program were implemented for 12 weeks, 3 exercises a week on Sunday and Tuesday and Thursday every week during the period from Sunday 12/04/2009 to Thursday 02/07/2009. The time of the main part of the module of the exercises in the beginning of the program lasts 30 minutes and then gradually the time increases until it reaches the end of the program (45 minutes). In general, the training intensity was moderate (60-75%) of the maximum of pulse rate after the application of the equation of maximum pulse (220-age), the program

contains free exercises without tools, exercises using a chair, exercises using the plastic ball and the exercise side with the ring each of the exercises last 3 weeks. Pilates exercises is characterized from others by breathing during the performance and selecting the timing of breathing (inhalation and exhalation) during the exercise according to different conditions interspersed with periods of relaxation to take a certain fixed positions (such as sit down-lie-kneeling) with the organization of the process of breathing during periods of relaxation.

**Statistical Analysis:** Researchers used these statistical treatments:

- C Median
- C Standard deviation
- C Skewness coefficient
- C Correlation coefficient
- C Significant differences between means by using nonparametric Wilcoxon method.
- C Significant differences between means by using nonparametric Mann-Whitney method
- C Percentage change (%)
- C Statistical program spss version 12
- C The level of statistical significance (0.05)

## RESULTS AND DISCUSSION

The results showed homogeneity of members of the research sample of women in the variables of chronological age, height and weight and the degree of depression, skewness coefficient ranged between -0.13

and -0.23, it has been narrowed down between  $\pm 3$  indicating that they lie within the curve equinoctial. Thus, the sample is equinoctial distributed indicating homogeneity of the sample (Table 1).

The existence of statistical significant differences between pre and post-measurements favoring post measurements in both biochemical and physiological variables. Z calculated values ranged between 2.81 and 2.86, the largest value of (z) indexed at the significance level (0.05) is indicated in Table 2.

Table 3 indicates the change rates between pre and post measurements, as change rates ranged between 4.04% and 47.57%, indicating a positive impact of pilates exercise program on all the variables under consideration.

Inverse correlation was found between the serotonin hormone and the depression degree in both pre and post-measurement, as the less the secretion of the serotonin hormone the more the depression degree, as explained in the pre measurement, while the post, measurement shows increasing secretion of serotonin hormone to near its normal limits less with the depression degree in the sample ranged values  $t$  calculated between -0.81 and -0.90, the two biggest of the value of (t) indexed at the significance level 0.05 are indicated in Table 4.

Table 5 shows the existence of statistical significant differences between women with high serotonin hormone concentration and women with low serotonin hormone concentration in the depression degree in the sample under consideration and in the direction of women with high concentration in the post-measurement as the value of calculated (z) is 2.14, the largest of the value of (z) indexed at the level of 0.05.

Table 1: Mean, median, Standard deviations and skewness coefficient and of the variables (age, height, weight, depression degree), N = 10

Variables	Measure unit	Mean	Median	Standard deviations	Skewness coefficient
Age	Year	32.20	33.00	3.05	-0.79
Height	cm	158.40	158.50	2.27	-0.13
Weight	Kg	74.20	74.50	1.75	-0.07
Depression degree	Degree	19.30	19	0.95	0.23

Table 2: Significant differences between pre and post -measurements of the sample under discussion in the biochemical, physiological, physical and psychological variables by nonparametric wilcoxon method, N = 10

Variables	Measure unit	Pre measure		Post measure		Z Value	
		M	S.D	M	S.D		
Biochemical	Serotonin hormone	Ng/ml	180.10	4.09	188.70	4.62	2.81
Physiological	Pulse rate	Pulse/m	78.00	1.94	73.80	1.75	2.84
	Systolic blood pressure	Mm Hg	128.70	4.00	123.50	2.32	2.81
	Diastolic blood pressure	Mm Hg	87.60	1.71	82.30	2.00	2.81
Physically	Muscularendurance	repetition	16.70	1.49	23.10	1.20	2.86
	Abdominal muscular endurance	repetition	20.60	1.65	25.30	1.89	2.82
	Flexibility	repetition	10.30	1.34	15.20	1.69	2.85
	Back strength muscle	Kgm	41.20	2.20	47.40	1.78	2.86
	Leg strength muscle	Kgm	45.30	1.83	50.60	2.07	2.86
psychological	Depression degree	degree	19.30	0.95	12.80	1.48	2.84

Z value at the 0.05 significance level = 1.96

Table 3: Change percentage between pre and post -measurements of the sample under discussion in the biochemical, physiological, physical and psychological variables, N = 10

Variables	Measure unit	Pre measure	Post measure	Percentage rate %	
Biochemical	Serotonin hormone	Ng/ml	180.10	188.70	4.78
Physiological	Pulse rate	Pulse/m	78.00	73.80	5.38
	Systolic blood pressure	Mm Hg	128.70	123.50	4.04
	Diastolic blood pressure	Mm Hg	87.60	82.30	6.05
Physically	Muscularendurance	repetition	16.70	23.10	38.32
	Abdominal muscular endurance	repetition	20.60	25.30	22.82
	Flexibility	repetition	10.30	15.20	47.57
	Back strength muscle	Kgm	41.20	47.40	15.05
	Leg strength muscle	Kgm	45.30	50.60	11.70
psychological	Depression degree	degree	19.30	12.80	33.68

Table 4: Correlation coefficients between serotonin hormone concentration and the depression degree for sample under consideration, N = 10

Variables	Pre measure	Serotonin hormone
Depression degree	Pre measure	-0.81
	Post measure	-0.90

Value (t) indexed at the level of 0.05= 0.738

Table 5: Significant difference between ladies with high serotonin hormone concentration and ladies with low concentration in depression degree by nonparametric Mann-Whitney method, N = 10

Variable	High concentration		Low concentration		Z Value
	M	S.D	M	S.D	
Depression degree	13.80	1.30	11.80	0.84	2.14

Z value at the 0.05 significance level = 1.96

It is clear from Table 1 the following:

- C skewness coefficient ranged between -0.13 and -0.23, it has been narrowed down between the  $\pm 3$ , indicating that they lie within the curve equinoctial. Thus, the sample is equinoctial distributed indicating homogeneity of the sample.

It is seen from Table 2 the existence of statistical significant differences between pre and post-measurements of the sample under discussion in the biochemical, physiological, physical and psychological variables favoring post measurements.

Table 3 indicates the change rates between pre and post-measurements, where change rates ranged between 4.04% and 47.57%, indicating a positive impact of pilates exercise program on the biochemical, physiological, physical and psychological variables under consideration.

It is seen from the Table 4 that there is a significant statistical relationship inverse correlation between the serotonin hormone concentration and the depression degree of the sample under consideration.

Table 5 indicates the existence of statistical significant differences between women with high serotonin hormone concentration and women with low serotonin hormone concentration in the depression degree in the sample under consideration in the direction of women with high concentration in the post-measurement as the value of (z) calculated is 2.14, the largest value of (z) indexed at the level of 0.05.

## DISCUSSION

Effect of exercise in general and in particular Pilates exercises on both serotonin hormone and depression degree:

Tables 2 and 3 indicate the positive effect of Pilates exercise program on each of the greater concentration of the serotonin hormone as well as reduction of the depression degree in women sample. Table 4 indicates the existence of inverse association between the hormone serotonin concentration and the depression degree where the greater the concentration of the hormone and in normal limits decreased the depression degree and vice versa. As shown in Table 5, women research sample who

were the focus of the serotonin hormone with the highest was the depression degree have less than women who have less in the hormone concentration.

The researchers attributed these differences and the improvement of the post measurements for the pre to Pilates exercise program designed by researchers and it consisted of exercises of moderate intensity, structured way and continuous, which was performed three times a week according to sound scientific basis, In addition to the exercise of stretching and muscle strength and organization are interspersed with breathing exercises and calming and relaxation, which were done with the accompanying music may have contributed to improvement of the feeling of happiness and that was directly reflected on their general mood, Also the researchers see that this improvement may be due to that during their participation in the implementation of training modules during the duration of the program, which led to a sense of fun and recreation and allowed them to share their feelings and build relationships and gain friendships with each other, which helped them to have a sense of optimism and increased confidence and the program includes organization of breathing exercises and calming and relaxation may have contributed to improving their ability to focus and increase the effectiveness and clarity of thinking,

This is consistent with what indicated by Karter [16] that exercises Pilates lead to a moderation of your mood and reduce tension and anxiety suffered by the individual during daily life. And also in line with what was noted by Tawfiq [17] that the practice of sports activities on a regular basis is a powerful means to improve the psychological aspects, sport is working on ideas to get rid of anxiety and tension and help to replace them with new ideas and happy. Also, El-Hagrasy [18] thinks that exercises if submit to the codification of scientifically oriented along the lines of physiological and biological, psychological, can become a way to reduce the incidence of disease and reduce the times of tension and stress. Rateb [13] suggests that the practice of physical activity is a tool for psychological treatment, such as depression and anxiety, it modifies mood and represents a kind of time-out, or break for a short period of the daily burden lead to reduced stress and anxiety and tension and improve the psychological aspects.

The consistent results of this study with previous studies [19-22] which indicated that various exercise programs and Pilates exercises can improve the psychological state of the women in this age group and lead to easing pressures that may be exposed. Tawfiq [17]

thinks that the pursuit of sporting activities on a regular basis is a powerful means to reduce the pressure and reduce the degree of frustration and get rid of the thoughts of anxiety and tension and help to replace them with new ideas and happiness, which reduces the pressure.

These results are consistent with prior studies [23-25] that the practice of sports lead to an improvement in the psychological state of the individual, leading to ease pressures and improve the frustration degree. Karter [16] emphasizes that Pilates exercise lead to an improvement in the work of the lungs, heart and blood vessels with increased strength and muscular endurance, muscle stretching and balance as well as works to moderate mood, relieving the tension, depression and stress in all aspects of life.

Serotonin, is a chemical in the brain that has been successfully linked to mood In particular, it is responsible for the availability of neurotransmitters at receptor sites. For the brain to maintain a stabilized mood, it must have balanced levels of serotonin. In cases of manic depression, the cause most often stems from either a lack of serotonin in the brain or inefficiency among the serotonin receptors. There are many researchers who believe that an imbalance in serotonin levels may influence mood in a way that leads to depression. Possible problems include low brain cell production of serotonin and lack of receptor sites able to receive the serotonin that is made.

Nicoloff and Schwenk [26] think that exercise increases the brain aminergic synaptic transmission. In other words, the monoamines in the brain, such as serotonin and dopamine, have an improved transmission rate when exercising occurs. This is beneficial for those depressed because such chemicals in the brain directly affect on mood. Even more convincing to some is the biological argument that supports the link between exercising and improved depression. Currently researchers are studying the various ways the mind alters on mood, placing much of their focus on the brain neurotransmitters. The two most highly publicized neurotransmitters are beta-endorphins and serotonin.

Delgado and Moreno [27 ] in addition to Maes and Meltzer [28] added that Serotonin and norepinephrine are two neurotransmitters that are involved in mood and are thought to be connected to depression. The Mayo Clinic notes that it is hypothesized that a deficit in either neurotransmitter can cause depression. Both serotonin and norepinephrine are targeted in antidepressants, which are intended to relieve depression symptoms. Yeung [29]

supports that except in the fact that extended exercise has been proven to increase the secretion of endorphins. Nafie and Mahmoud [21] and Musa [22] indicated an increase in both interleukin-2 and beta-endorphin hormones after Pilates exercises program for 12 weeks.

The researchers think that beside the positive effect of Pilates exercise program by increasing the concentration rate of the hormone serotonin in women sample, the nutrition may have a role in this increase, as the center offers for residents three meals a day (breakfast, lunch and dinner) and the researchers are in agreement with the Center Department modifying these diets component to include foods that help to increase the serotonin hormone concentration.

Satalkar [30] says that serotonin is made up of an amino acid called 5-HTP, which is made from another amino acid called tryptophan. Both of these are found in protein-rich foods, such as meat, fish, beans and eggs, Spinach is high in folic acid, Foods also high in vitamin B, such as bananas and avocados, can be beneficial to your mood as they convert tryptophan into serotonin. By eating these types of food, you are helping your body to produce more serotonin and it can therefore boost your mood.

Exercise can do a lot to improve mood and across the board, studies have shown that regular exercise can be effective as treatment for depression as antidepressant medication or psychotherapy., many Results demonstrated that physical activity reduces depressive symptoms regardless of the intensity level.

However, women who participated in at least 60 minutes of moderate-to-vigorous exercise a week had significantly fewer symptoms of depression than those who were active for less than 1 hour a week [31]. A study at the University of British Columbia demonstrated that physically inactive women are 15.7 times more likely to be depressed than women who have a normal activity level [32]. In another study, 52 sedentary women participated in a 10-week resistance-training program. Women who had positive feelings about the resistance-training program showed a significantly greater decrease in total mood disturbance, than those who had negative feelings about exercising [33]. A study that examined 20 women who had given birth in the last 12-months and were experiencing depression discovered that those who improved their fitness levels through exercise had fewer depressive symptoms than less fit individuals [34]. A study at the University of Tartu demonstrated that women who participate in physical activity 3 times a week have significantly better mental health and less

depression than inactive women. Even women who participate in physical activity 1-2 times a week have better mental health [35].

Effect of exercises in general and in particular Pilates exercises on physiological variables (pulse-blood pressure):

Tables 2 and 3 point out to the positive effect of pilates exercise program by reducing each of the pulse rate and blood pressure at rest in women sample, the researchers attributed these differences and improvement in the post measurements for the pre to pilates exercises program which includes a set of exercises that lead accompanied by music and the organization of breath during the performance, which led to a sense of fun, less stress and strain, with an adaptation of Physiology helps to raise the efficiency of the vital body organs, as it decreased rates of pulse and blood pressure and this means that the efficiency of the circulatory system and of the low rates of pulse and blood pressure due to the positive impact of the program, which includes stretching exercise and muscle strength and included in the exercise of calm and relaxation and done in moderate intensity, added a new dimension in improving the physiological efficiency of the heart and blood vessels.

As also in line with what was noted by Badran [14] that exercise has benefits both physical and psychological, physiological, it strengthens muscles, increases joint flexibility and works to stimulate blood circulation, reduce stress and attribute it to that when exercise improve the functional status of league and respiratory system, are filled lungs with inhalation air and increase the amount of oxygen connecting the brain and muscles, as well as to strengthen the muscles that lead to avoid feeling pain and muscle spasm, while reducing the degree of feeling stress and increase the ability to meet the requirements of life. Rateb and Abed Rabbo [36] think that the regularity in training affects the heart, as its condition improved by Expansion his chambers and increase the size of the impulse and as a result of that heart rate decreased at rest, which leads to feed the heart through the coronary arteries better.

Tawfiq [17] thinks that continue the training that make the body in a relaxed state and less stress, arousal and influenced more than in the absence of the physiological efficiency of the physical effort. This finding corresponds with the study of Jago *et al.* [6] that practicing Pilates exercises leads to the improvement of the pulse and blood pressure, affect the functioning of cardiovascular system, muscles and various elements in the endocrine system.

Reduced levels of stress as well as improved respiratory and circulatory systems are all direct benefits of Pilates training. Likewise, the advantages and benefits of resistance training are many. Research has proven that resistance training is beyond all doubt, the most effective training available for increasing skeletal muscle and even bone mass. For some, an increase in bone mass could have far-reaching benefits, as could an increase in skeletal muscle. Amongst the many associated benefits is, increased bone mineral density, reduced body fat, increased strength and improved heart condition. Medical studies have proven that resistance training lowers heart rate and blood pressure, thus reducing the risk of heart disease

Elpek [37] emphasizes that repeated the training load for weeks and months to help the player to perform training load more easily and with higher capacity and manifested by decreased pulse rate at rest. Rushdie [38] adds that physical exercise increases the rated capacity to extract more oxygen from the blood that allows the reduction in blood flow rate to active muscles and thus decrease heart rate.

According to researchers, Pilates exercises program leads to lower blood pressure at rest and after the effort because of the positive changes associated with regular training for a long time to the heart muscle and the efficiency of blood vessels and improve blood components, which may have resulted in pilates exercises to activate venous blood circulation and increase blood return to the heart and the expand during physical activity in addition to increasing the number of opened capillaries in the tissue cells, which leads to the adaptation of arteries to the needs of cells and makes blood flow easily inside the arteries and capillaries during contraction of the heart and thus lower systolic blood pressure and the increasing expansion of capillaries blooming during physical activity may leads to a decline in peripheral resistance to blood flow in the arteries leading to lower diastolic blood pressure. Due to the high blood pressure rate for members of the research sample before the implementation of the research experiment taking into account at the beginning of the search experience the principle of gradualism in Training load as well as to take into account some of the climatic conditions such as high temperatures and also follow some guidelines of food and to avoid being subjected to fatigue and to ensure attendance in the research experience without the occurrence of any damage or side effects.

Hayes [39] and Abdel Wahab [40] explain that the practice of aerobic exercises lead to low blood

pressure as it is when pushing the heart blood strikes straight to the organs of the body through the blood vessels, it is happening pressure on blood vessels and therefore increase the capillaries in the size and number will lead to low blood pressure in both effort and comfort.

These results are consistent with results of the study done by Musa [22] which aimed to identify the Pilates training program effect for 12 weeks by 3 exercises per week on a sample of women aged from 35-40 years and concluded that the Pilates training program had positively affect the reduction of the pulse and blood pressure rates at rest. This current study results agree with studies results of other studies [22, 41] which conclude to Pilates exercises program improvement both pulse and blood pressure rates at rest, affect the functioning of cardiovascular system, while the result not agree with study results of Schroeder *et al.* [42] which conclude to Pilates exercises program does not elicit a heart rate response within an appropriate target heart rate range in order to improve cardiorespiratory endurance.

Effect of exercises in general and in particular Pilates exercises on physical variables (strength, muscular endurance and flexibility):

Tables 2 and 3 indicate the positive effect of Pilates exercise program on these physical variables the women's sample, these differences and improvement rates in the post measurements for pre Pilates exercise program and what it involves training leads to the strengthening of large body muscles such as abdominal and back muscles and legs, in addition to the contents of the program includes exercises to lengthen the muscles and ligaments surrounding the cartilage and lead to flexibility.

**Flexibility:** Pilates exercises work to increase the degree of flexibility and elasticity of the joints of the pelvis muscles and tendons, which led to improve the degree of flexibility.

Improved flexibility is due to pilates training which is working to increase flexibility at the same time gives the strength to the muscles, which helped to improve the flexibility of the joints and trunk from the front, back and increase the strength and rubber to the muscles and thus minimize the possibility of exposure to injuries [5, 16]. Stretching exercise one of the basis of flexibility developing as they increase the susceptibility of muscle to extend and reduce the resistance as it res the contractions of muscle more effectively with a reduced risk of injury, muscular fatigue and to improve the performance level [43, 44].



Pilates exercises helps strengthen the deep abdominal muscles, the back and thigh muscles and work to lengthen the muscles around the spine to relieve the pressure it also helps in modifying the body which is suffering from arching in the back and rounded the shoulders and is used in rehabilitation, as it helps to gain balance in the whole body, it also works to strengthen and lengthen muscles, increasing range of joint movement, which reduces the likelihood of injury when the performance.

**Muscle Strength:** The pilates exercises program contains a set of exercises for different groups of body muscles, helping to increase muscle strength, as Brekaa and Fawzy [43] think that as a result of the training several physiological changes of the muscle occur in the size of muscle fibers of the individual and thus increase the ability of the nervous system to provoke contraction of the fiber, leading to increased productive force of the muscle and patterns of breathing accompanied by not only the impact of these exercises to achieve strength, endurance, flexibility and balance, but also extends to the rehabilitation of the body from all aspects. Abdul Fattah [45] thinks that flexibility and stretching helped to increase the production of strength as they are limiting inflation of muscle resulting from strength training and reduces the internal resistance in the muscle so increases the power and speed of defibrillation.

Pilates exercises program which contained a total of physical movements that use the weight of the body's resistance and designed to strengthen all muscle groups in the body, including legs and back muscles, is also working to develop prolongation and muscle tone for each muscle, including the muscles around the spine and help Pilates exercises to create balance in the muscles and coordination between the parts of the body and improve muscle strength and thus improved performance and also that indicated by Karter [16].

**Muscular Endurance:** Continuing Pilates exercises Program for 12 weeks or the equivalent of 36 training module has helped to raise muscular endurance degree and this depends mainly on the muscles strength as improve muscular endurance has link with improved muscle strength.

Salama [10] indicates that regular training leads to increase the efficiency of the muscle and that is reflected in the ability of muscle to produce muscle strength, which increases the speed of muscle contraction as well as to improve endurance capacity, which depends on muscle

strength. Kroos and Rothmaier [46] said that the increase in muscle strength, flexibility and stretching lead to increase the capacity of the practitioner to withstand fatigue, as there is a positive relationship between each of the muscular endurance and strength the more strength increased muscle endurance and vice versa.

According to researchers improvement in muscular endurance as a result of continue training by moderate intensity with the progression in time from 30 min to 45 min and repetition over a period of 12 weeks has led to the lifting of the degree of muscular endurance and this depends on the strength of muscles, as well as the pilates exercise program a structured exercise for all body muscle groups as they work to move all the muscles in the body simultaneously with the importance of taking into account the six principles for the performance of pilates exercises (focus, control, breathing, central, precision, flow and continuity). King [1] explains that pilates exercises performed slowly, agility and continuity and not stop until the completion of the performance of the required number to repeat the exercise. Karter [16] adds that pilates training to increase stamina and the possibility to continue the performance for a long time due to the transfer of the largest amount of oxygen during the breathing process for each cell in the body to generate the necessary energy and disposal of combustion products that cause fatigue and thus becomes a bear the largest individual.

This is consistent with what was noted by Aldnchara [47] that exercise works to strengthen muscles and increase flexibility, leading to increased human capacity to withstand fatigue and make efforts that are difficult for a person who is not the practitioner to the sports afford. And also in line with previous studies [44, 47] that the regular training and continuous exercises prolonging muscle and ligaments surrounding the cartilage serve to increase the flexibility of joints and the prevention of diseases, as well as move them without pain.

The consistent results of this study with the results of prior studies [3, 4, 19, 22,48] that the different exercise programs and Pilates exercises has a positive impact on improving the physical variables such as the strength of the muscles of the abdomen, back, legs and flexibility of the spine from back and front. They also reduce spinal injuries and reduce low back pain is not organic. According to the researchers, the program of Pilates exercises led to a sense of pleasure and fun and reduce the degree of tension, anxiety and strengthen the large muscles in the body such as the arms muscles, abdomen, back and legs, as well as stretching exercises of the muscles and ligaments around the joints leads to its flexibility.

Aldnchara [47] indicates that exercise works to strengthen muscles and increase the size of their flexibility, leading to increased human ability to withstand fatigue and the effort and this is consistent with prior studies [44, 47] that the regular and continuous for stretching muscles and surrounding ligaments exercises are useful in increasing the flexibility of joints and the prevention of diseases, as well as move without feeling pain. These results are consistent with the study of both Blum [3] and Rydeard *et al.* [4] that practicing Pilates exercises have a positive impact on the improvement of spinal injuries and pain relief joints. Prior studies [21, 48-51] indicate a positive effect of Pilates exercises on abdominal and lower back muscular strength, abdominal muscular endurance, muscle strength muscular endurance and flexibility for different sample females.

### CONCLUSION

Pilates exercise program for 12 weeks has a positive impact on reducing the depression degree, improving both heart and blood pressure rates, muscle strength, muscular endurance and flexibility for battered women research sample.

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