

Effect of Pilates Exercises on Primary Dysmenorrhea among Adolescent Female Students

Eman Ahmed El-Kholy¹ and Ahmed Ebrahim Shalaby²

¹Lecturer of Maternal and Neonatal Health Nursing, Faculty of Nursing, Tanta University.

²Lecturer of Sports Health Sciences, Faculty of Physical Education, Kafr El Shak University.

Abstract:

Background: Dysmenorrhea is the most common gynecological symptoms among adolescent female students that negativity affects their daily life activities, academic achievement and productivity. **The aim of this study:** Was to determine the effect of Pilates exercises on primary dysmenorrhea among adolescent female students. **Subjects and Method:** The study was conducted at Faculty of Nursing Tanta University Egypt. A purposive sample consisted of 100 female students who had primary dysmenorrhea and fulfilling the inclusive criteria. The students randomly allocated into study and control groups 50 students in each group. Two tools were used: **Tool (I): Self-administered sheet:** included three parts: (a) **Bio-socio-demographic** data of the students, (b) **Menstrual history.** **Tool (II):** included three parts: (a) **Visual Analogue Scale (VAS),** (b) **Dysmenorrheal duration assessment sheet** and (c) **Measurement of plasma cortisol level** through a venous blood sample. **Results:** revealed that mean scores of the students dysmenorrheal severity, duration, as well as plasma cortisol level had significantly decreased among the study group compared to the control group ($P= 0.0001$). **Conclusion:** Pilates exercises significantly decreased the dysmenorrheal intensity and duration as well as plasma cortisol level among adolescent female students. **Therefore, the study recommended** that Pilates exercises should be incorporated into nursing curriculum and practice as a method for relieving primary dysmenorrhea among adolescent female student.

Key words: Pilates exercises, Primary Dysmenorrhea, Adolescent Female Students.

Introduction

Adolescence is a transitional stage from childhood to adulthood, which involves dramatic physical, sexual, psychological and social developmental changes. The major physiological change that takes place during this stage is menstruation which is a hallmark of puberty for adolescent female. It can be defined as cyclic or periodic shedding of the endometrium. Menstruation frequently is associated with variety of problems, the most common one of them is dysmenorrhea⁽¹⁻³⁾.

Dysmenorrhea is a painful menstruation that incapacitating adolescent females from performing their normal daily living and has

adverse effects on their quality of life as it affects their academic achievement and productivity. The term dysmenorrhea is derived from the Greek words *dys* means difficult, painful or abnormal, *meno* means month and *rrhea* means flow^(4,5), which is one of the most commonly gynecological symptoms as it's reported incidences in Egypt were 87.5% and 92.9% in 2017 and 2018, respectively^(6,7). Moreover, in Sri Lanka it was 97.7% in 2021 and in Saudi Arabia the estimated incidence was 90.5% in 2022^(8,9).

Generally, dysmenorrhea is classified into two broad categories primary and secondary. Primary dysmenorrhea is a painful menstruation, which occurs in absence of

any pelvic pathology and usually begins when ovulatory cycles started. On the other hand, secondary dysmenorrhea is a painful menstruation, which is associated with pelvic pathology such as; endometriosis, ovarian cysts or tumors and cervical stenosis that commonly occurs after 30 years old^(6,9,10).

Actually, primary dysmenorrhea (PD) begins on the first day of menstruation and reaches its maximum within 24 hours. It starts when the bleeding is slight and improves as the flow becomes well established. Usually, pain is felt in the supra pubic region and radiates to inner and front sides of the thighs. The exact cause of PD is unknown but most of symptoms can be explained by the action of prostaglandins that releases from the endometrial layers and stimulates uterine contraction resulting in uterine ischemia that producing pain^(3,11,12).

Primary dysmenorrhea is usually associated with hyper-arousal of the hypothalamic–pituitary–adrenal system, which results in elevated serum cortisol hormone level. Subsequently, the high cortisol level enters the circulation suppressing the growth of the body's immune cells and affects the release of adrenaline neurotransmitters. This results in blockage of the Gonadotropin Releasing Hormone (Gn-RH) secretion. Consequently, resulting in impaired Follicular Stimulating Hormone (FSH) and Luteinizing Hormone (LH) that lead to menstrual disorders including dysmenorrhea and repeating this vicious cycle again and again⁽¹³⁻¹⁵⁾. So, proper management is recommended.

Fortunately the nurse plays a very important role in pain management through offering comfort measures and reassurance to relieve pain. These measures are either pharmacological or non-pharmacological. Non-pharmacological pain management of

primary dysmenorrhea avoids undesirable side effects of pharmacological management. This pharmacological management includes Non-steroidal anti-inflammatory drugs, oral contraceptive pills or even surgical method. On the other hand, non-pharmacological management includes hot bath, hot drinks, acupuncture, acupressure, massage, aromatherapy, reflexology and physical exercises^(6,16).

Pilates exercises are holistic system that created by Joseph Pilates since 1920 and consisted of movements by uniting flexibility, strength, breathing, and relaxation. They belong to a group which called Body-Mind Exercises that focuses on controlled movement, posture, and breathing, they are safe, non-invasive treatment modality to relief primary dysmenorrhea. Pilates either are done through using a mat or another apparatus according to its type.

Significance of the study

Dysmenorrhea affects both the quality of life and development of motherhood. As, Pilates exercises improve mental and physical well-being, increases flexibility, strengthens muscles and subsequently decreasing pain⁽¹⁷⁻¹⁹⁾. Therefore, this study was conducted to determine the effect of Pilates exercises on primary dysmenorrhea among adolescent female students.

Aim of the study

The aim of this study was to determine the effect of Pilates exercises on primary dysmenorrhea among adolescent female students.

Subjects and Method

Research design:

A quasi experimental research design was utilized in this study.

Setting:

The study was conducted at Faculty of Nursing Tanta University Egypt.

Subjects:

A purposive sample consisted of 100 female students aged from 17- 22 years, single, had primary dysmenorrhea for three previous consecutive cycles with moderate or severe degree of pain based on Visual Analog Scale and were willing to participate in the study. They had no chronic medical diseases or pelvic pathology, didn't use hormonal therapy during the last 6 months, didn't take analgesic for relieving pain during the study period, and didn't practice any regular exercise activity. The students were randomly allocated into two groups; the study group consisted of 50 female students to whom an instructions and demonstration training about how to perform Pilates exercises had applied and the control group consisted of 50 female students who were used their usual habits.

IV- Tools of data collection:

To achieve the aim of the study the following two tools were used for data collection:

Tool (I): Self-administered sheet:

This tool was developed by the researchers after reviewing of the related literature^(1,8,9,18) and was used to collect basic data about the students. It included the following two parts:

Part I: Bio-Socio-demographic data of the students: It included age, telephone number, E-mail, residence and BMI.

Part II: Menstrual history: It included age at menarche, rhythm, interval and duration of menstruation, amount of menstrual bleeding by counting number of saturated pads and dysmenorrhea characteristics (onset, degree, location, associated

symptoms of pain and any previous methods used to relieve dysmenorrhea).

Tool (II): Dysmenorrheal assessment sheet: to determine the severity and duration of the dysmenorrhea. It included the following two parts:

Part I: Visual analogue scale (VAS): It was adopted by the researchers to assess dysmenorrheal severity (pain intensity). It is a self-reported device consisting of 10 cm straight line, which represents a continuum of pain intensity and has verbal anchors at its opposite ends representing no pain, to pain is bad as it can be. Pain intensity was evaluated by asking the student to point to the number on line that represented the intensity of their pain. The scores corresponding to the pain intensity as shown on the line are: - No pain (0), Mild pain (1-3), Moderate pain (4-6), Severe pain (7-10)⁽²⁰⁾.

Part II: Dysmenorrheal duration assessment sheet: It was developed by the researchers to determine the duration of dysmenorrhea pre-intervention (baseline measurements) and eight weeks post-intervention.

Part III: Laboratory investigation: It was done to assess the plasma cortisol level through a venous blood sample that was taken at the morning on the first day of menstruation for all students.

Methods**1. Approval:**

-An official letter clarifying the purpose of the study was obtained from the responsible authorities in the Faculty of Nursing to conduct the study.

2. Development of the tools:

- **Tool I** and **Tool II** (Part II) was developed by the researchers after the extensive review of the relevant and recent literatures^(1,8,9,18). Then, it was validated by

a jury of three experts in the field of obstetrics and gynecological nursing and three experts in the field of physical education, the face validity of the tool was calculated based on experts' opinion after calculating content validity index (%) of its items and it was 94.5%.

- **Tool II** (Part I) was adopted from **McCaffery and Pasero (1999)**⁽²⁰⁾.

-**Tool II** (Part III) was adopted from **El-Bably E and Abd El-azziz Kh (2019)**⁽²¹⁾.

-**Tool I and Tool II** reliability were tested using Cronbach's Alpha test which was 0.89, 0.90 respectively, that indicates an accepted reliability of the tools.

3. Ethical considerations:

-The purpose of the study was explained to each student and an oral and written consent to participate in the study was obtained from them, nursing students have been informed about confidentiality of the information, benefits and right to withdraw from the study at any time if desired. In addition ethical considerations for collection of blood samples were followed.

4. A pilot study:

-A pilot study was carried out on 10% of the total sample (10 students) to test the clarity, feasibility and applicability of the developed tools for the purpose of their modification and clarification. In addition, steps of Pilates exercises were evaluated for their simplicity and applicability. Those students of the pilot study were included in the study sample as there were no changes or modifications in the tools.

5. **Data collection:** data was collected over a period of four months started at 20/2/2022 and ended on 20/6/2022.

6. The study was conducted as follow:

I- Assessment and planning phase:

-To fulfill the aim of the research, the researchers started with reviewing national and international literatures regarding

different aspects of the research topic to be aware of its dimensions and guide them to make tools of data collection.

-Total number of the female students of the first year of nursing faculty at Tanta University at the beginning of second semester of the academic year (2021/2022) were 294 students. All of those students were first screened by an assessment sheet developed by the researchers regarding characters of their primary dysmenorrhea and estimates the prevalence and intensity of primary dysmenorrhea using Visual Analogue Scale.

-All completed sheet have been reviewed by the researchers. It was found that (262) students were complained from dysmenorrhea with moderate and severe intensity that corresponds well to the characteristics of primary dysmenorrhea indicated in the recent literature review^(1,8,9,18).

-A simple random technique was used in this study to ensure obtaining a represented sample of first year faculty nursing students. According to the equation of power analysis 100 female students who fulfilled the study criteria were selected randomly from the previously mentioned setting by the researchers.

-Intensity of the students' dysmenorrhea was assessed pre-intervention using **Tool II** (Part I) and duration was assessed pre-intervention using **Tool II** (Part II). Meanwhile, fasted, resting students' plasma cortisol level was assessed through a venous blood sample that was taken at the morning on the first day of menstruation for all students pre-intervention using **Tool II** (Part III). After tourniquet application on the right/left upper arm blood was collected in 5 ml syringe through 16 gauge needle taking all aseptic precautions from the right/left

cubital vein. Blood samples were collected between 8:00 – 9:00 am at the same conditions to avoid diurnal variations. 3 ml of blood was transferred to a plain bulb and kept undisturbed for half an hour for the separation of serum from it. The serum collected from this bulb was used to estimate the serum cortisol levels. The serum cortisol levels were measured by using an immunoradiometric assay (IRMA).

II- Implementation phase:

- The study subjects were divided into two equal groups randomly (study and control), 50 students in each group. The purpose of the study was explained to each group. Then written consent to participate in the study was obtained.
- The researchers had divided the *study group* into small groups 5 students in each training session. They watched a video that was developed by the researchers about Pilates exercises for better understanding of Pilates exercises' training. Then demonstration of the Pilates exercises steps were done by the researchers in front of them including the following protocol: Warming up exercises, Core exercises which involved; waist stretch, spine stretch I, spine stretch II, spine twist, child pose, windmill, the saw, the mermaid, half curl, tiny step, the hundred I, rolling like a ball, rolling down, single leg circle, single leg stretch, double leg circles and finally followed by cooling exercises. It was followed by re-demonstration by each student that was carried out in front of the researcher more than one time to ensure their ability to do the Pilates exercises correctly. Then the students among the study group were practice Pilates exercise training three days/week for 40 min/day for eight weeks. Pilates exercises brochure and video were given to each student among the study group. Students were informed not to

perform Pilates exercises during days of menstruation. The researchers instructed the students to stop the use of any pain relieve measure at this time other than Pilates exercises.

- The *control group* used their usual habits but didn't use any medications to relief dysmenorrhea.

II. Evaluation phase:

- Intensity of the students' dysmenorrhea was assessed pre and eight weeks post intervention using **Tool II** (Part I) among study and control groups.

-Duration of students' dysmenorrhea was reassessed pre and eight weeks post intervention using **Tool II** (Part II) among study and control groups.

-Students' plasma cortisol level was assessed through a venous blood sample that was taken at the morning on the first day of menstruation for all students pre and eight weeks post intervention using **Tool II** (Part III) among study and control groups.

-Comparison was done two times pre and eight weeks post starting the Pilates exercise program to determine the effect of Pilates exercises on primary dysmenorrhea among adolescent female students.

Statistical analysis:

The collected data were organized, tabulated and statically analyzed using SPSS software (Statistical Package for the Social Science, Version 16, SPSS Inc. Chicago, II, USA).

Results

Figure (1): Shows that the prevalence rate of primary dysmenorrhea among all first year Faculty of Nursing female students at Tanta University was 89.12%.

Table (1): Presents the socio-demographic characteristics among the studied students (study and control groups). It was found that the mean age of the study group was 18.41 ± 0.79 years corresponding to 18.52 ± 63

years among the control group. It was also, observed that more than half (56% and 52%, respectively) of the study and control groups had born in urban areas with no statistically significant differences between the two groups ($\chi^2=1.107$, $P= 0.06$). This table also clarifies that the mean body mass index of the study group was (25.74 ± 4.45) (kg/meter^2) corresponding to (24.69 ± 5.25) (kg/meter^2) among the control group with no statistically significant difference between two groups ($\chi^2= 1.280$, $P= 0.203$). This means that the study sample was homogenous.

Table (2): Portrays the menstrual history among the studied students (study and control groups). It was reported that less than three quarters (70.0% and 74.0%, respectively) of them had their menarche at (11-<13) years with no significant differences between the two groups ($\chi^2= 0.38$, $P= 0.828$) and most (90.0% and 94.0%, respectively) had a regular menstruation, with no significant difference between the two groups ($\chi^2 = 0.100$, $P= 0.752$).

Concerning the menstrual cycle interval, table (2) also reveals that the majority of the studied students of the study and control groups (96.0% and 94.0%, respectively) had an interval of 28-30 days with no significant differences between the two groups ($\chi^2= 0.702$, $P= 0.402$), regarding the duration of menstrual bleeding, exactly half of them had duration ranged from 6-7 days with no statistically significant differences between the two groups ($\chi^2= 0.813$, $P= 0.032$). In addition, less than two thirds (60.0% and 62.0%, respectively) of the study and the control groups had moderate menstrual flow (2-3 pads/day).

Table (3): Illustrates characteristics of dysmenorrhea among the studied students

(study and control groups). It was declared that (80% and 84%, respectively) of the study and the control groups stated that dysmenorrhea began with the onset of the menstruation and continue for 48 hours with no statistically significant differences between both groups ($\chi^2= 0.518$, $P= 0.772$). As regards to location of dysmenorrhea, it was noticed that less than two third (64.0% and 66.0%, respectively) of them felt pain on lower abdomen, whereas, more than half (54.0% and 56.0%, respectively) of the groups felt pain in lower back. Moreover, more than half (52.0% and 56.0%, respectively) used non-pharmacological methods to relive their dysmenorrhea.

Figure (2): Portrays the total score of dysmenorrheal severity among the studied students (study and control groups) pre and post-intervention. It clarifies that less than two thirds (66.0% and 62.0%, respectively) of them had severe degree of dysmenorrhea pre-intervention. While, none of study group had severe dysmenorrhea compared to (50.0%) among control group post-intervention.

Table (4): Shows the mean score of dysmenorrheal severity (menstrual pain intensity) among the studied students (study and control groups) according to Visual Analogue Scale (VAS) pre and post-intervention. It was obvious that the mean score of VAS were (8.05 ± 1.84 and 7.93 ± 1.81 , respectively) among study and control groups pre-intervention with no statistically significant difference ($Z=0.562$ and $P=1.772$). While, post-intervention there were significant decreases in the mean score of VAS among the study group to 0.67 ± 1.30 compared to 6.48 ± 2.17 among control group with statistically significant difference ($Z =7.645$ and $P=0.0001$).

Table (5): Shows the mean and standard deviation of dysmenorrheal duration among the studied students (study and control groups) pre and post-intervention. It was evident that the mean and standard deviation of the dysmenorrheal duration were (4.94 ± 1.19 and 4.25 ± 1.01 , respectively) among study and control groups pre-intervention with no statistically significant difference ($Z = 0.202$ and $P = 0.223$). On the other hand, post-intervention there were a significant decrease in the mean and standard deviation of dysmenorrheal duration among the study group (1.67 ± 0.48) compared to (4.02 ± 1.17) among the control group with a statistically significant difference ($Z = 8.785$ and $P = 0.0001$).

Table (6): Displays the mean and standard deviation of plasma cortisol level among the studied students (study and control groups) pre and post-intervention. It was noticed that the mean and standard deviation of plasma cortisol level were (17.64 ± 1.19 and 17.25 ± 1.01 , respectively) among them pre-intervention with no statistically significant difference ($Z = 1.838$ and $P = 0.399$). On the other hand, post-intervention there were a statistically significant decline in the mean and standard deviation of plasma cortisol level among the study group (13.82 ± 1.48) compared to (16.82 ± 1.17) among the control group with statistically significant difference ($Z = 10.545$ and $P = 0.0001$).

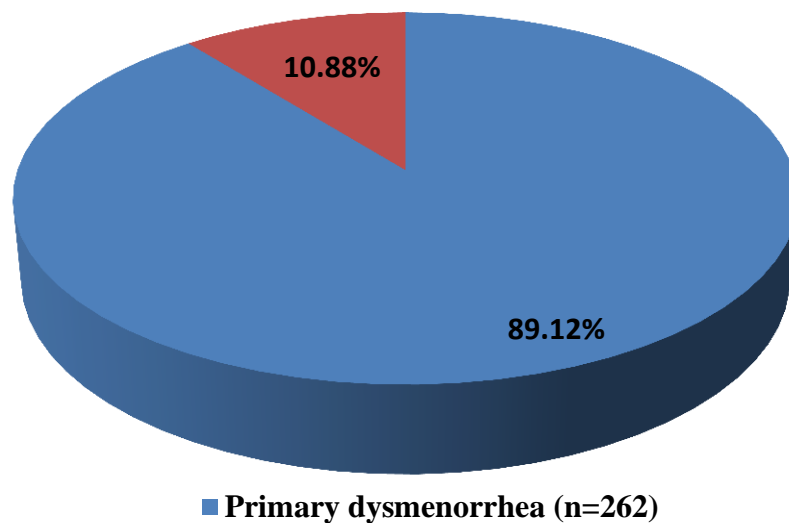


Figure (1): Prevalence rate of primary dysmenorrhea among all first year Faculty of Nursing female students at Tanta University (n=294).

Table (1): Percent distribution among the studied students (study and control groups) regarding their Socio-demographic characteristics.

Variables	Students (n=100)				χ^2	P
	Study group (n=50)		Control group (n=50)			
	n	%	N	%		
Age (years): Range Mean±SD	17-20 18.41±0.79		18-20 18.63±0.52		1.992	0.059
Residence: Rural Urban	22 28	44.0 56.0	24 26	48.0 52.0	1.107	0.060
Body mass index (BMI) (kg/meter²): Range Mean±SD	17.58-32.41 25.74±4.45		17.33-31.99 24.69±5.25		1.280	0.203

*Significant ($P < 0.05$)**Table (2): Percent distribution among the studied students (study and control groups) regarding their menstrual history.**

Variables	Students (n=100)				χ^2	P
	Study group (n=50)		Control group (n=50)			
	N	%	n	%		
Age of menarche (years): 9-<11 11-<13 13-<15 15-17	7 35 4 4	14.0 70.0 8.0 8.0	8 37 3 2	16.0 74.0 6.0 4.0	0.38	0.828
Rhythm of menstruation: Regular Irregular	45 5	90.0 10.0	47 3	94.0 6.0	0.100	0.752
Interval of menstrual cycle (days): <28 28-30	2 48	4.0 96.0	3 47	6.0 94.0	0.702	0.402
Duration of menstrual blood flow (days): 2-3 4-5 6-7 8-10	7 14 25 4	14.0 28.0 50.0 8.0	10 13 25 2	20.0 26.0 50.0 4.0	0.813	0.032
Amount of menstrual blood (No. of pads /day): Slight (One) Moderate (2-3) Excessive (≥ 4)	11 30 9	22.0 60.0 18.0	8 31 11	16.0 62.0 22.0	0.127	0.047

*Significant ($P < 0.05$) χ^2 : Chi-square test

Table (3): Percent distribution among the studied students (study and control groups) regarding their characteristics of dysmenorrhea.

Variables	Students (n=100)				χ^2	P
	Study group (n=50)		Control group (n=50)			
	N	%	N	%		
▪ Onset of dysmenorrhea:						
- Before the menstrual period	10	20.0	8	16.0	0.518	0.772
- With onset of the menstruation & continue for 48 hours	40	80.0	42	84.0		
#•Location of dysmenorrhea:						
- Lower abdomen	32	64.0	33	66.0	0.139	0.709
- Lower back	27	54.0	28	56.0	3.367	0.067
- Lower limbs	17	34.0	15	30.0	1.008	0.315
- Perineal area	13	26.0	17	34.0	2.559	0.278
- Knee	9	18.0	6	12.0	0.326	0.568
#•Associated symptoms with dysmenorrhea:						
- Fatigue & tiredness	47	94.0	45	90.0	0.901	0.343
- Drowsiness	33	66.0	28	56.0	1.714	0.190
- Nausea & vomiting	32	64.0	30	60.0	0.034	0.853
- Diarrhea	30	60.0	28	56.0	0.035	0.852
- Constipation	26	52.0	22	44.0	0.045	0.831
- Headache	24	48.0	25	50.0	0.036	0.849
- Restlessness	23	46.0	22	44.0	1.645	0.200
#•Previous methods used to relieve dysmenorrhea:						
- Pharmacological	9	18.0	5	10.0	0.139	0.709
- Non-Pharmacological	26	52.0	28	56.0	0.564	0.453
- Both	15	30.0	17	34.0	0.315	0.575

*Significant (P<0.05)

 χ^2 : Chi-square test

#: More than one answer was chosen

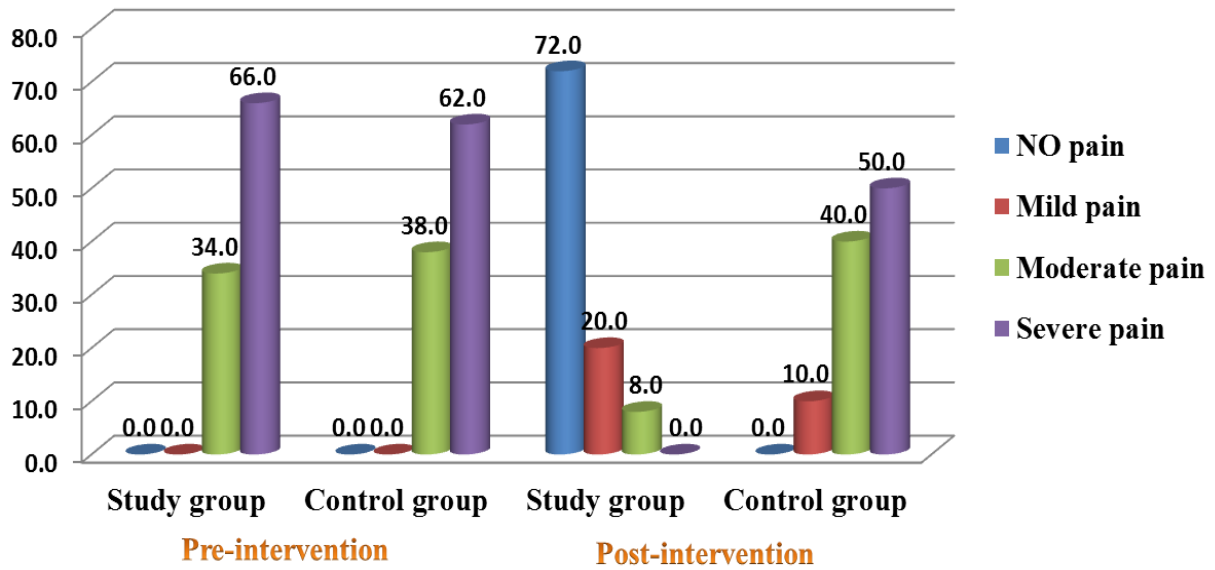


Figure (2): Total score of dysmenorrheal severity among the studied students (study and control groups) pre and post-intervention

Table (4): Mean score of dysmenorrheal severity (menstrual pain intensity) among the studied students (study and control groups) according to Visual Analogue Scale (VAS) pre and post-intervention.

Dysmenorrheal severity	Students (n=100)		Z value	P
	Study group (n=50)	Control group (n=50)		
Pre-intervention : Range Mean±SD	5-10 8.05±1.84	5-10 7.93±1.81	0.562	1.772
Post-intervention : Range Mean±SD χ^2 value P	0-5 0.67±1.30 41.557 0.0001*	2-10 6.48±2.17 2.852 0.265	7.645	0.0001*

*Significant ($P < 0.05$)

χ^2 value of Friedman test

Z value of Mann-Whitney test

Table (5): Mean and standard deviation of dysmenorrheal duration among the studied students (study and control groups) pre and post-intervention.

Dysmenorrheal Duration	Students (n=100)		Z value	P
	Study group (n=50)	Control group (n=50)		
•Pre- intervention : Mean±SD	4.94±1.19	4.25±1.01	0.202	0.223
•Post-intervention : Mean±SD	1.67±0.48	4.02±1.17	8.785	0.0001*
χ^2 value	33.634	6.101		
P	0.0001*	0.412		

*Significant ($P < 0.05$) χ^2 value of Friedman test Z value of Mann-Whitney test

Table (6): Mean and standard deviation of plasma cortisol level among the studied students (study and control groups) pre and post-intervention.

Plasma cortisol level	Students (n=100)		Z value	P
	Study group (n=50)	Control group (n=50)		
•Pre-intervention : Mean±SD	17.64±1.19	17.25±1.01	1.838	0.399
•Post-intervention : Mean±SD	13.82±1.48	16.82±1.17	10.545	0.0001*
χ^2 value	14.634	6.101		
P	0.0001*	0.412		

*Significant ($P < 0.05$) χ^2 value of Friedman test Z value of Mann-Whitney test

Discussion

Dysmenorrhea is the most common gynecological complaint, as well as the leading cause of recurrent short term absenteeism among adolescent female students. It is a painful menstruation which interferes with the daily life activities and is associated with variety of morbidities. Therefore, implementation of Pilates exercises training for management of primary dysmenorrhea with the avoidance of side effects of pharmacological management is a crucial intervention for adolescent female students.

The result of the current study declared that the prevalence rate of primary dysmenorrhea among all first year Faculty of Nursing students at Tanta University was 89.12%. This result aligns with **Abo-Hatab T (2017)**⁽⁶⁾, and **Hashem Sh et al (2018)**⁽²²⁾, who proclaimed that the prevalence rate among Tanta University students were (87.5% and 85.6%, respectively). In the same line, **Shehata N et al (2018)**⁽⁷⁾ and **Aljahadi I et al (2022)**⁽⁹⁾ found that the prevalence of dysmenorrhea is (92.9% and 90.5) in Egypt and Saudi Arabia, respectively. On the other hand, **Mesele T.**

et al (2022)⁽²³⁾, mentioned that the rate of dysmenorrhea was 64.7%. As regards to the socio-demographic characteristics among the studied students (study and control groups), the findings of the current study demonstrated that the two groups were homogenous in their age, residence and body mass index as there were no statistically significant difference between both groups.

Regarding menstrual history, the result of the present study declared that less than three quarters of both groups had their menarche at (11-<13). This result is similar to **Sima R et al (2022)**⁽²⁴⁾ who proclaimed that the mean age of menarche were 12.39 ± 1.33 . In addition, most of the studied students (the study and control groups) had regular menstruation with interval of 28-30 days. This finding was in concurrence with **Abo-Hatab T (2017)**⁽⁶⁾ who noticed that most of the students had regular menstruation with an average interval between 28-30 days. Additionally, **Hashem Sh et al (2018)**⁽²²⁾ partially agreed with the present study findings, they demonstrated that the majority of the studied nursing student had regular menstruation and more than one half of them had interval of >27-35days.

Moreover, exactly half of the studied students had a duration of menstrual bleeding ranged from 6-7 days. This finding is aligned with **Akbas E (2019)**⁽²⁵⁾ who demonstrated that the mean duration of menstruation was 6.10 ± 0.87 . Also, the current study revealed that less than two thirds of both the study and the control groups had moderate menstrual flow (2-3 pads/day). This result is in the same line with **Moghadam R (2019)**⁽²⁶⁾ who reported that less than two thirds of the studied medical students had moderate menstrual

flow (2-3pad /day). Despite that the age of menarche, the menstrual rhythm, interval and duration as well as the amount of menstrual blood loss were within normal range, but this not prevent the students from experiencing dysmenorrhea.

Concerning the characteristics of dysmenorrhea, the present the study findings declared that the majority of the studied students in both groups experienced dysmenorrhea that began with the onset of the menstruation and continued for 48 hours. This result is in line with **Abo-Hatab T (2017)**⁽⁶⁾ and **Hashem Sh et al (2018)**⁽²²⁾, who accounted that nearly two thirds of the students of both groups reported pain, which started with the onset of menstruation and continued during the first 48 hours. Literature reviews also supported this result where shedding of the endometrial lining leading to release of prostaglandins which reaches its maximum within 48 hours.

As regards to location of dysmenorrhea, the present study presented that less than two thirds of the study and the control groups felt pain on their lower abdomen, whereas, more than one half of them felt pain in the lower back. These findings were in agreement with **Mohamed H and Hafez A (2017)**⁽²⁷⁾, and **Hashem Sh et al (2018)**⁽²²⁾, who found that the studied students felt pain in lower abdomen followed by lower back. Moreover, the current study findings concluded that more than half of study and control groups used non-pharmacological methods to relieve their dysmenorrhea.

In relation to the intensity of dysmenorrhea, the results of the present study demonstrated that less than two thirds of the study and the control groups had severe degree of dysmenorrhea pre-intervention. While, none of the study group

had severe dysmenorrhea compared to half of the control group post-intervention, in addition the mean score of dysmenorrheal severity (menstrual pain intensity) was significantly decreased among the study group compared to the control group post-intervention. These findings are in agreement with **Paithankar S and Hande D (2016)**⁽²⁾, **Fonseca J et al, (2016)**⁽²⁸⁾, **Wahyuni M (2016)**⁽²⁹⁾, and **Oswal N et al (2017)**⁽³⁰⁾ who reported that Pilates exercises were effective in reducing dysmenorrheal intensity. **In the same line, Ali Z et al (2017)**⁽³¹⁾, elaborated that Pilates exercise with caraway supplementation reduce the perception of dysmenorrhea in adolescent non-athlete girls. Again, **Chang E et al (2018)**⁽³²⁾, elaborated that Pilates stabilization exercises and kinesio taping are effective in decreasing dysmenorrhea in female university students.

Furthermore, the present findings were in congruence with, **Gopagar M and Devi P (2020)**⁽³³⁾, **Cahyanto E et al (2021)**⁽³⁴⁾, and **Purba R et al (2021)**⁽³⁵⁾, who investigate the effect of Bosu Pilates, Mat Pilates and Pemberian Pilates exercises respectively on primary dysmenorrhea and declared that these exercises significantly reduce the degree of the dysmenorrhea. Despite none of these studies conducted in Egypt, they have the same findings of our study as exercises increase vasodilatation, release of endogenous especially beta endorphins and suppress prostaglandins subsequently shutting of blood flow from viscera resulting in less pelvic congestion and relieving pain as well as hormonal balance resulting in decline of dysmenorrheal intensity.

On the subject of dysmenorrheal duration among study and control groups' pre and post-intervention, our study displayed a

significant decrease in the mean and standard deviation of dysmenorrheal duration among the study group compared to control group post-intervention. This finding went hand in hand with **Salehi F et al (2012)**⁽³⁶⁾, who found that Pilates exercises were effective in reduction of the duration of the primary dysmenorrhea. Supporting the current study findings **Rezvani S. et al., (2013)**⁽³⁷⁾, **Karami E and Ghasemi B (2014)**⁽³⁸⁾, **Mohamed H and Hafez A (2017)**⁽³¹⁾, and **Moghadam R et al (2019)**⁽²⁶⁾, who study the effect of aquatic exercises, both kegal & stretching exercises, pelvic rocking exercises and plan based exercises respectively, they stated that exercise significantly decreased the duration of primary dysmenorrhea. From the researchers point of view these findings attributed to the fact that exercises has the ability to release of endorphins leading to rise of pain threshold in addition to improve blood flow to the uterus subsequently relieves ischemia and ultimately reduce pain duration.

Concerning the plasma cortisol level among study and control groups pre and post-intervention, it was noticed that there was no significant difference between both groups pre-intervention, while there was significant decline in the mean and standard deviation of plasma cortisol level among the study group compared to control group post intervention. This finding was supported by **Septianingrum Y and Hatmanti N (2019)**⁽¹⁴⁾, who stated that there was a correlation between cortisol level and menstrual pain. In addition, in accordance with the current study findings **El-Bably E and Abd-Aziz K (2019)**⁽²¹⁾, who reported that there was a significant decrease in plasma cortisol level among the study group who was treated by Pilates exercises. The

harmony of previous studies with the present study may be aroused from the fact that functional menstrual disorders as dysmenorrhea is associated with an increase in cortisol level. Moreover, movements in Pilates exercises are linked to concentration of the mind when performed smoothly but precisely that leads to reducing menstrual pain, as well as cortisol level.

Conclusion

Based on the findings of the present study, it can be concluded that Pilates exercises significantly decreased the dysmenorrheal intensity and duration, as well as improved plasma cortisol level among the studied adolescent female students

Recommendations

- Educational programs are to be established to increase awareness of adolescent female students about dysmenorrhea, factors contributing to it, and its side effects, importance of timely referral and how to improve self-care measures.
- Incorporating Pilates exercises as a complementary and alternative therapy into nursing practice and curriculum as a method for relieving primary dysmenorrhea among adolescent female student.
- In service training program for nurses about developing Pilates exercises as method to decrease dysmenorrhea.
- Mass media should be utilized for dissemination of simple, correct and relevant information about non pharmacological methods for management of dysmenorrheal pain especially Pilates exercises.

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