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# Effect of William's Flexion Exercises on Menstrual Pain, Depression and Sleep Quality among Nursing Students with Primary Dysmenorrhea

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**Abstract**: Adolescents often encounter dysmenorrhea, which is a common issue that greatly affects the quality of life for females. A beneficial approach to alleviate dysmenorrhea is through William's Flexion Exercise. This technique is considered one of the most efficient complementary therapies due to its affordability and absence of adverse effects **Purpose** :to evaluate the effect of William's flexion exercise on menstrual pain, depression and sleep quality among female nursing students with primary dysmenorrhea. **Design**: A quasi experimental design (One-Group, Time series quasi-experimental design). **Setting**: The research was conducted at the Faculty of Nursing, Benha University. **Sample**: A purposive sample of 76 female nursing students. **Instruments**: Five instruments were used: A structured self-administered questionnaire, Numeric pain rating scale, Patient health questionnaire-9 and Pittsburgh sleep quality index. **Results**: There was a statistical significant improvement in female nursing students' total knowledge score regarding dysmenorrhea at 4 weeks and 8 weeks post-intervention compared to pre-intervention. As well as, there was a statistical significant improvement in total mean scores of the pain severity, depression level and quality of sleep among female nursing students at 4 weeks and 8 weeks post-intervention compared to pre-intervention. **Conclusion**: The implementation of William' flexion exercise was effective in reducing level of menstrual pain, depression level and improving quality of sleep among female nursing students with primary dysmenorrhea. **Recommendation**: It was recommended that William' flexion exercises should be incorporated into as a complementary and alternative therapy into nursing education and curriculum as a method for relieving primary dysmenorrhea.

***Keywords***: *Depression, Menstrual Pain, Primary Dysmenorrhea, Sleep Quality, William's Flexion Exercise*

Introduction

Dysmenorrhea is a common gynecological issue that affects many women of childbearing age, causing severe cramping in the lower abdomen before or during menstruation. It often goes undiagnosed, as many women choose not to seek medical help due to reasons such as insufficient knowledge about menstrual health, financial constraints, or dissatisfaction with medical recommendations (Chéileachair et al., 2022).

Dysmenorrhea may be classified as primary, in the absence of pelvic abnormalities, or secondary, often resulting from conditions such as endometriosis, uterine fibroids, and pelvic inflammatory disease. Primary dysmenorrhea is more common and usually affects adolescents and young women. Primary dysmenorrhea has multiple contributing factors, including a family history of dysmenorrhea, early onset of menstruation, sleep disturbances, lack of physical exercise, lumbopelvic misalignment, and insufficient abdominal muscle strength. Additionally, recent studies indicate a connection between dysmenorrhea and psychological factors such as stress, depression, and anxiety (MacGregor et al., 2023).

The etiology of primary dysmenorrhea is attributed to uterine muscle ischemia, a result of excessive uterine contractions during menstruation. The precise cause of primary dysmenorrhea remains uncertain. It is theorized that reduced progesterone levels in the luteal phase, along with the excessive production of prostaglandins and inflammatory mediators, play a role in the ischemic and hypoxic conditions of the uterus. Consequently, this heightened state leads to an amplified sensation of pain in dysmenorrhea. (López-Liria et al., 2021).

Primary dysmenorrhea is responsible for about 10% of debilitating menstrual pain experienced by adolescent and young adult females. Furthermore, it is intense enough to cause significant social and economic impairment, particularly among adolescents and young women. In the United States, dysmenorrhea is linked to an estimated loss of 600 million work hours and 2 billion dollars in economic productivity. It also adversely affects students' academic achievements, as well as stress causes young girls to withdrawal from or absence in school (Muluneh et al., 2021).

Worldwide, past epidemiological studies have indicated that the prevalence of dysmenorrhea varies from 41.7% to 94%. In the African region, the occurrence of primary dysmenorrhea also varies from 51.1% to 88.1%. (Hu et al., 2020; Dengeingei et al., 2020).

Psychological conditions like depression, anxiety, and stress could potentially have a two-way relationship with dysmenorrhea. The occurrence of chronic menstrual pain on a monthly basis may heighten the likelihood of developing depression, anxiety, or stress, and vice versa. In certain instances, the presence of these psychological disorders can worsen the intensity of menstrual pain. Simultaneously experiencing

depression and dysmenorrhea could amplify the perception of pain severity and diminish the effectiveness of medication (Pakpour et al., 2020).

The impact of sleep habits on dysmenorrhea is considered to be a significant modifiable lifestyle risk factor, but it is uncertain whether menstrual problems lead to poor sleep or vice versa. There is a possibility that sleep and menstrual problems have a mutually reinforcing relationship, creating a cycle of negative influence. Recent studies indicate that low sleep quality, insomnia, and insufficient sleep duration are associated with dysmenorrhea in adults. Disrupted sleep can potentially worsen dysmenorrhea by triggering inflammation, which is an underlying cause of the condition. Additionally, poor sleep has the potential to intensify stress, a well-known risk factor for dysmenorrhea (Wang et al., 2022; Conzatti et al., 2021).

Various methods can be utilized to alleviate dysmenorrhea aside from administering medication. These include non-pharmacological approaches such as relaxation techniques, distraction techniques, and skin stimulation techniques. Stretching exercises, for instance, can help activate muscle function by producing heat and utilizing energy from the breakdown of Adenosine Triphosphate (ATP) and oxygenated calcium activity. This process aids in improving blood circulation and substance transportation within the muscles, ensuring that substances like lactic acid flow smoothly (Amila et al., 2021).

William's Flexion Exercise is designed to enhance the strength of the abdominal muscles and promote mobility in the lower lumbar region. By engaging in lower abdominal and lumbar muscle contractions, individuals can apply pressure to the major blood vessels in the abdominal region, resulting in improved blood circulation throughout the body, including the reproductive organs. As a result, this can help increase the delivery of oxygen to constricted blood vessels, ultimately reducing menstrual pain (Astuti and Adhkana, 2019).

Obstetrics and gynecological nurses often serve as the first point of contact for adolescent students who experience menstrual cramps. However, these nurses have a unique opportunity and responsibility to actively address issues related to menstruation in order to improve the well-being and health of students. It is important for them to offer appropriate guidance to adolescents on how to effectively manage menstrual cramps and encourage the use of safe complementary therapy methods (Angelhoff and Grundström, 2023).

**Significance of the study:**

Dysmenorrhea, a prevalent gynecological and menstrual disorder, impacts a significant number of women in their reproductive years. According to Sima et al. (2022), millions of women experience this condition during their reproductive years. The World Health Organization (WHO) has reported that more than half of the population in all countries suffers from severe dysmenorrhea,

while 10-15% experience milder symptoms. The prevalence of dysmenorrhea is particularly high among young women, with estimates ranging from 67% to 90% for those aged 17 to 24 years. In Europe, dysmenorrhea affects 45-97% of women, while in America, the range is 52-90%. In Africa, the prevalence is between 44-95%, and in Asia, it affects 45-90% of women (WHO, 2021).

Dysmenorrhea has a negative impact on multiple facets of life, encompassing sleep quality, work efficiency, attendance, social interactions, and can result in substantial financial strain due to medical costs and care. Additionally, it exerts detrimental effects on adolescents, manifesting as fatigue, lower back pain, anxiety, stress, depression, headaches, mental fog, queasiness, vomiting, diarrhea, stomach cramps, and abdominal pain, while also disrupting daily activities. Furthermore, dysmenorrhea among adolescents can disrupt their ability to effectively participate in teaching and learning, causing difficulties in concentration, a tendency to sleep in class, ultimately impacting academic and non-academic achievements (Dewi and Runiari, 2019).

Creating suitable management techniques and non-pharmacological approaches, such as William's flexion exercises, is crucial in mitigating the health effects of dysmenorrhea in adolescent girls. William's flexion exercises are a cost-effective, easily accessible, self-administered non-pharmacological intervention that plays a significant role in nursing care for gynecological patients. This systematic approach aids in alleviating stress, anxiety, pain, muscle tension, contractions, and enhancing sleep quality (Muluneh et al., 2021). Therefore, this study aimed to evaluate the effect of William's flexion exercise on menstrual pain, depression and sleep quality among female students with primary dysmenorrhea.

**Purpose:**

To evaluate the effect of William's flexion exercises on menstrual pain, depression and sleep quality among nursing students with primary dysmenorrhea.

**Research hypotheses:**

- H1: Nursing students will show less menstrual pain after practicing William's flexion exercise.
- H2: Nursing students will show less depression level after practicing William's flexion exercise.
- H3: Nursing students will show high sleep quality after practicing William's flexion exercise.

**Operational definitions:**

- **Williams exercises:**
  Known as Williams lumbar flexion exercises, are a series of therapeutic movements and stretches designed to alleviate lower back pain and improve spinal flexibility. These exercises aims to target specific muscles in the lumbar region while promoting proper spinal alignment.
- **Primary dysmenorrhea:**
  spasmodic and painful cramps in the lower abdomen that begin shortly before or at the onset of menses in

the absence of any pelvic pathology , one of the most common complaints in both young and adult females Its onset occurs mainly during adolescence, within 6 to 24 months after menarche

## Subjects and method

### Research design:

A quasi experimental design (One-Group, Time series quasi-experimental design) was adopted for this research. According to Cambell, and Slanley (1966), "The term quasi-experimental design pertains to a research design type that does not incorporate random assignment." This study began from October 2022 to the end of June 2023 covering nine months.

### Setting:

This research was conducted at the Faculty of Nursing, Benha University.

### Sampling:

A Purposive sample of 76 female nursing students. Total number of nursing students enrolled in first academic
year 2022/2023 was (1093); (332) Male and (761) Female. Ten percent of female nursing students (76 female students) were selected and was chosen according to the following **inclusion criteria**: Female nursing students who registered in first academic year, suffer from primary dysmenorrhea, did not take any medication and mineral supplements during the last three menstrual cycles and free from chronic and psychological diseases.

### Instruments:

Four instruments were used for data collection:

**Instrument (I): A structured self-administered questionnaire:**

It contained two parts:

- **Part one**: Personnel characteristics of the female students. It included five items (age, marital status, residence, mother' education, mother' occupation).
- **Part two**: Menstrual history: It included five items (age at menarche, duration of menstrual flow, amount of blood flow, length of menstrual cycle, menstrual cycle regularity).
- **Part three**: knowledge related dysmenorrhea: This part was developed by researchers after reading relevant literature (Al Ajeel et al., 2020; Dengeingei et al., 2020) to assess female nursing student's knowledge about dysmenorrhea. It included 7 items (definition, causes, types, risk factors, signs and symptoms, complications, management).

**Scoring system of knowledge:**

Each item was assigned a score of (2) given when the answer was correct, a score (1) was given when the answer was incorrect. The total knowledge score was calculated by summation of the scores for the correct answers. The higher scores reflect higher levels of knowledge about menstruation. The score of total knowledge was classified as the following:

- Inadequate knowledge: less than 60%
- Adequate knowledge: 60% to 100%

**Instrument (II): Numeric Pain Rating Scale (NRS):**

This tool was adopted from Polat et al., (2009) for assessing menstrual pain. The NRS are using a 10-point rating scale ranging from 0 (no pain) to 10 (worst pain).

**Scoring system:**

The pain scores are interpreted as: (0) represented no pain. (1-3) indicated a mild pain, (4-7) refereed a moderate pain, and (8-10) reflected the severe pain. This scale was chosen for its ease of administration and comprehensiveness.

**Instrument (III): Patient Health Questionnaire-9 (PHQ-9):**

This tool was adapted from Kroenke et al., (2001) and encompassed 9 items to assess depression level during the previous 2 weeks. The Likert scale for each item has 4-point scale: (0)"Not at all", (1)"Several days", (2)"More than half the days", and (3)" Nearly every day ". A total score for each participant was calculated by summing the scores of the responses to each item, total scores range from 0 to 27, with higher scores indicating more-severe depressive symptoms.

**Total depression scoring system**:

- No depression (0) point
- Minimal depression (1 to 4) points
- Mild depression (5 to 9) points
- Moderate depression (10 to 14) points
- Moderately severe depression (15 to 19) points
- Severe depression (20 to 27) points

**Instrument (IV): Pittsburgh sleep quality index (PSQI):**

Pittsburgh sleep quality index was adopted from Carole, (2007) to measure the quality and patterns of sleep during previous month. It consisted of 19 statements. PSQI yielded seven domains related to sleep habits including: Subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication and daytime dysfunction.

**Scoring system:**

Seven component scores, ranging from 0 (no difficulty) to 3 (severe difficulty), were derived and summed to produce a total score (ranging from 0 to 21). Higher scores indicate worse sleep quality.

The PSQI was interpreted into 4 levels of sleep quality.

- Good sleep quality (PSQI $\leq$ 5)
- Mild sleep quality disturbance (PSQI: 6 - 10)
- Moderate sleep quality disturbance (PSQI: 11 - 15)
- Poor sleep quality (PSQI $\geq$ 16).

**Validity**

To check the validity, the data collection tools were presented to a panel of three nursing specialists in the field of obstetrics and gynecology. Modifications were made in response to the board's feedback regarding the clarity of the sentences and the appropriateness of the content.

**Reliability**

The reliability of instrument was tested using Cranach's alpha test, which

revealed that the tools have consistent properties.

| Tool | Cronbach's alpha value |
|---|---|
| **Tool I- Part 3**: Knowledge regarding dysmenorrhea | 0.88 |
| **Tool II**: Numeric Pain Rating Scale (NRS) | 0.93 |
| **Tool III**: Patient Health Questionnaire-9 (PHQ-9) | 0.90 |
| **Tool IV**: Pittsburgh sleep quality index (PSQI): | 0.92 and it ranged from 0.82 to 0.94 in the seven domains |

**Ethical considerations:**

The approval for the research was secured from the Scientific Research Ethical Committee at the Faculty of Nursing, Benha University prior to the initiation of the study. Furthermore, official authorization was obtained from the designated research locations to conduct the study. Before the interviews and throughout the research period, every student was briefed on the research's purpose and benefits. Written consent was obtained from each student before the data collection process began. The students were reassured that their data would be kept confidential and used exclusively for research purposes. Their autonomy and integrity were safeguarded, and they were given the option to withdraw from the study at any time without facing any consequences.

**Pilot Study:**

A pilot investigation was conducted on a subset of the overall sample (10%), consisting of eight students, in order to assess the effectiveness and relevance of the research instruments, as well as to determine the amount of time required to complete them. As no adjustments were made to the tools, the students who participated in the pilot study were also included in the main sample.

**Field work:**

In order to achieve the objective of the research, the study was divided into several stages. These stages included the preparatory phase, the phase of conducting interviews and assessments, the planning phase, the implementation of William's flexion exercises, and the evaluation phase. The entire study spanned a duration of nine months, started from October 2022 and concluding in June 2023. Throughout this period, the researchers made regular visits to the mentioned locations twice a week, specifically on Sundays and Tuesdays, between 9 a.m. and 2 p.m. taking into consideration the students' available study time.

**Preparatory Phase:**

The initial stage of the study involved conducting a thorough review of both local and international literature related to the different aspects of the research issue. This allowed the researchers to gain a better understanding of the magnitude and severity of the problem at hand, and also provided guidance for developing the necessary data collection instruments. These instruments were then given to three experts from Obstetrics and Gynecological Nursing, in order to evaluate their suitability, comprehensiveness, clarity, importance, and applicability. Based on the recommendations of the experts, certain items were omitted

**Interviewing and assessment Phase:**

During this stage, the researchers conducted interviews with the students in order to gather initial data. The interviews took place in the educational lecture hall at the faculty of nursing – Benha University. At the start of each interview, the researchers warmly greeted the students and provided them with a clear explanation of the research's objectives, duration, and activities. The researchers distributed the structured self-administered questionnaire (Instrument I) to assess students' personal characteristics, menstrual history and knowledge regarding dysmenorrhea. Then, the researchers distributed Numeric pain rating scale (Instrument II) (pre-test) to assess the severity of their menstrual pain, Patient health questionnaire-9 (Instrument III) (pre-test) to assess their depression level and finally Pittsburgh sleep quality index (Tool IV) (pre-test) to assess their sleep quality. The information gathered in this stage served as the foundation for future analysis to assess the impact of William's flexion exercises. The average duration for completing all assessments ranged from 20 to 30 minutes.

**Planning phase:**

Based on baseline data obtained from interviewing and assessment phase and relevant review of literatures, printed colored guidelines booklet and video regarding dysmenorrhea and patterns of William' flexion exercises were developed by the researchers to manage the students' deficit knowledge and practices regarding dysmenorrhea. Sessions' number and its contents, different methods of teaching, and instructional media were determined.

**Implementation phase:**

The duration of the implementation sessions spanned a period of 15 weeks. The students were categorized into 10 small groups, with each group consisting of 7-8 students. This grouping was based on their availability, theoretical lectures, and practical sections, ensuring their easy participation in the sessions and successful completion of their academic responsibilities. Every group underwent three interactive sessions per week, lasting for two consecutive weeks, with each session lasting between 45 to 60 minutes. Different educational techniques and resources were employed, such as adapted lectures, group discussions, role-playing, demonstrations and re-demonstrations, power point presentations, video films, and a specially designed booklet. Following each session, the queries raised by female students were addressed to rectify any misconceptions. The subsequent session commenced with a review of the previous session and an overview of the goals for the new session.

**1) The first session. (Theoretical)**

The session covered knowledge regarding dysmenorrhea, including its definition, causes, types, risk factors, signs and symptoms, complications, and its management.

**2) The second and third sessions (Practical)**

The sessions included practicing of William' flexion exercise which includes nine patterns of flexion exercise (the first five patterns of William' flexion exercises were demonstrated and re-demonstrated in the first practical session and the remaining of the nine patterns included in the second practical session).

The researcher taught the female nursing students how to apply patterns of William' flexion exercise adopted from Alfi, (2022) as the following:

**Pattern 1**

Initial movement position, the female student sleeps on his back nice mattress but a bit hard. Both knees bend and both feet flat on the surface of the mat. Flatten waist with press waist down against the mat with Contract the abdominal and buttock muscles. Every contraction hold for 5 seconds then relax. Repeat this exercise 10 times.

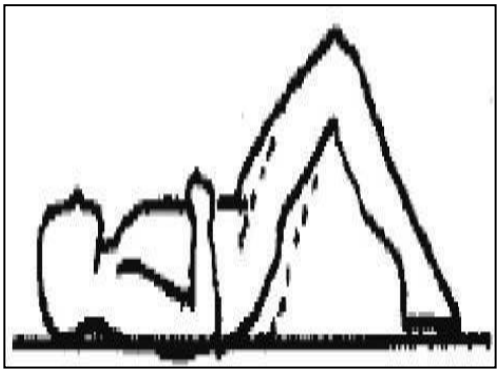

**Figure I: Movement position 1**

In the first movement there is strengthening of the abdominal muscles because in the first movement the muscle contracts pressing hands placed under the back (or pressing towards the mattress).

**Pattern 2**

The starting position of movement 2 is the same as the starting position Movement 1. Contract the abdominal muscles and flex the head so that chin touching chest and shoulders lifted until off the mat, then hold for 5 seconds then relax. Do this exercise 10-25 time.

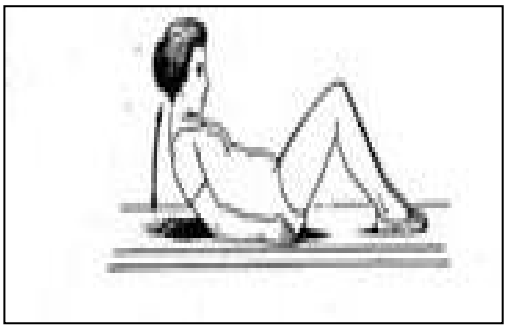

**Figure II: Movement position 2**

In this second movement, stretching occurs in the muscles lower back and strengthening abdominal muscles. That matter due to the movement of the two muscles in the back is pulled and there is pressure on the stomach (muscle contraction stomach) when lifting the head towards the chest

**Pattern 3**

The starting position of movement 3 is the same as the starting position Movement 1. Flex one knee towards your chest as far as possible, then both hands reach the hamstrings and pull his knees to his chest. At the same time raise head so chin touching chest and shoulders off the mat, and hold for 5 seconds. This exercise is repeated with the other leg. Done 10 times.

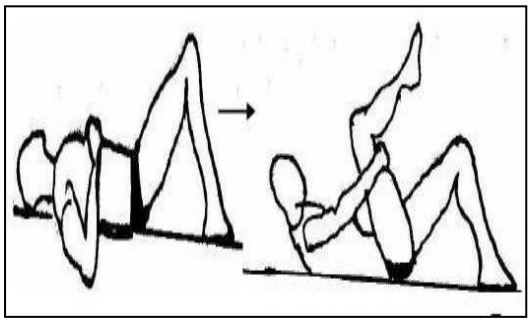

**Figure III: Movement position 3**

The third movement is to flex one leg in a direction thighs, contraction occurs in the front thigh muscles, namely quadriceps femoris, but on the contrary there is stretching of the muscles the back of the thigh bicep femoris. Apart from that, it also happens strengthening of the abdominal muscles because this movement also occurs pressure on the stomach (contraction of the abdominal muscles) when the legs are flexed and the head is raised closer to the chest.

**Pattern 4**

The starting position of movement 4 is the same as the starting position movement 1. This exercise is the same as movement position exercise 3, but both knees are bent, raised up and pulled both hands towards the chest. Raise head and shoulders off the mat. This exercise is repeated 10 times. Warning: when raising both legs up as far as possible, then pulled both hands close to the chest.

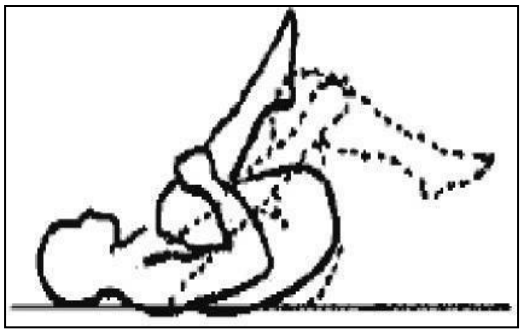

**Figure IV: Movement position 4**

In the fourth movement, flex both legs towards the chest then there is a contraction of the abdominal muscles, the opposite happens stretching the gluteus maximus muscle and hamstrings namely the biceps femoris.

**Pattern 5**

One leg straight back, one the other leg bends forward, both arms straight on the mat and support back straight forward. Move it back down so that the chest hits the thighs several times. After the pelvic moves up and down, together with the waist several times. Then alternate with the other leg. Movement repeated 10 times.

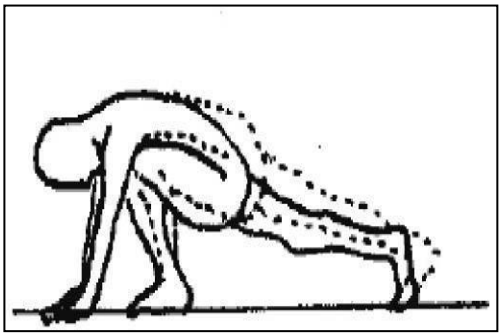

**Figure V: Movement position 5**

In this fifth movement, the position of the legs is like the starting movement in running, that is, one leg is flexed with the other leg straight backwards, after that the body leans forward, so that on This movement causes stretching of the back muscles, quadriceps femoris, and gastrocnemus. Meanwhile in the thigh muscles behind the contraction occurs.

**Pattern 6**

The student's position is standing with back leaning against the wall. Both feet are 10-15 cm from the wall. Flatten back against the wall keeping the back flat, the student walks away from the wall. Average back resistance

10 seconds, then the time to hold the back flat, increases to the best of his strength.

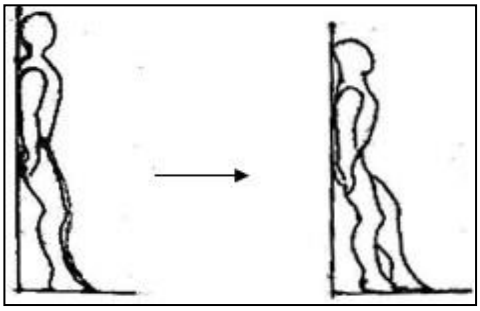

**Figure VI: Movement position 6**

In the sixth movement the student leans against the wall with walking away from the wall, thus the muscles are keep the back flat and pressed against the wall. Thus, the muscles in the back the back contracts and presses against the wall.

**Pattern 7**

Position initially the student sleeps on the back with the arms straight up, with both knees bent. Then the student is given a bath stand up with the arms straight. This movement is repeated 10 times.

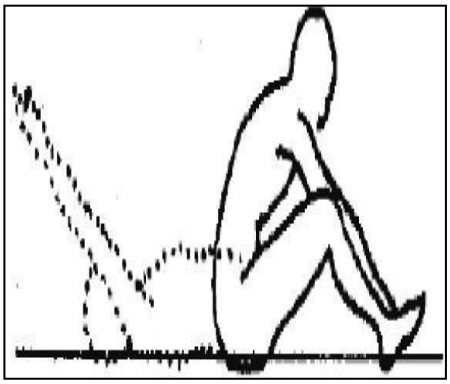

**Figure VII: Movement position 7**

In the seventh movement, the muscles contract abdominal, so this movement can strengthen the muscles on the stomach.

**Pattern 8**

The female student's position is sitting upright with both legs straight forward. Then with both arms straight in front of the body bend down to reach the toes. Head and back not can flex, so it doesn't cause problems to back.

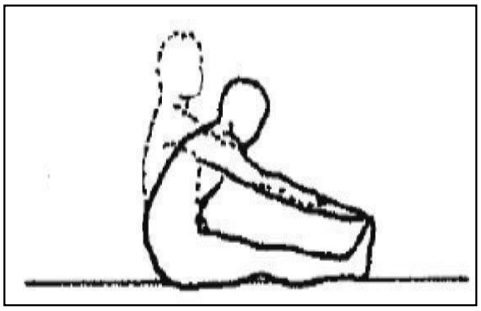

**Figure VIII: Movement position 8**

In the eighth movement there is stretching of the muscles back, hamstrings namely biceps femoris, and on part of the calf, namely the gastrocnemius

**Pattern 9**

The female student stands with the back slightly bent, both arms straight down slightly forward, legs slightly flexed on the knee. Then the students keeps both hands and feet fixed in place, sit crouched and both hands touch mat, then stand up again. This action is repeated 10 times.

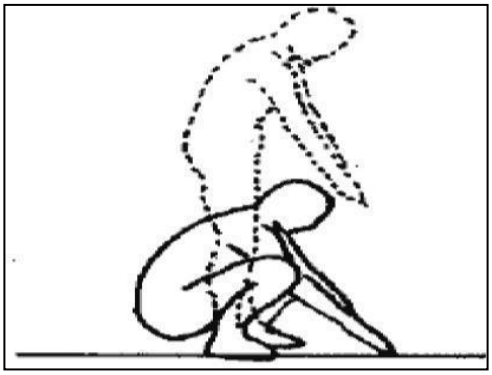

**Figure IX: Movement position 9**

In the ninth or last movement there is a stretch on the back and front thighs, but the opposite happens contraction of the hamstrings and abdominal muscles.

At the end of the practical sessions, an educational video explaining the nine patterns of William' flexion exercises were shown, the female students were asked to re-demonstrate these patterns of William' flexion exercises immediately after training to ensure their mastery of these exercises. The students were advised to practice William' flexion exercises twice/day (once in the morning and once in the evening) at the first three days of the menstrual period.

**Evaluation phase:**

The female nursing students were evaluated 4 weeks and 8 weeks after practicing all pattern of William' flexion exercises. The female nursing students' knowledge regarding dysmenorrhea, pain intensity, depression level, and sleep quality were evaluated used Pre-posttest tools (Instrument I – Part 3, II, III, and IV).

**Statistical Design:**

The collected data underwent organization, coding, computerization, and analysis through the utilization of SPSS version 22 (Statistical Package for Social Sciences). Descriptive statistics, such as mean, standard deviations, frequencies, and percentages, were employed. Pearson correlation coefficients, independent t-tests, and Chi-square tests were utilized. In all conducted statistical tests, a p-value greater than 0.05 indicated no statistically significant difference, a p-value less than 0.05 indicated a statistically significant difference, and a p-value less than or equal to 0.001 indicated a highly statistically significant difference.

**Results**

**Table 1**: clarifies that, 65.8% of the female students were in the age group of 18 - <19 years old with mean age of 18.05±0.58 years. Also, 96.1% of them were single. As well as, 56.6% of the female students were lived in a rural area. Moreover, 47.7% had mothers with secondary education and 68.4% of their mothers were house wife.

**Table 2**: reveals that, 59.2% of the female nursing students had their menarche at the age group of 11-13 years and that the duration of menstrual flow for 61.9% of the female students ranged from 3 to 7 days. The amount of blood flow for 77.6% of the female students was 2–4 pads/day and the length of the menstrual cycle for 88.2% of them was 21–35 days. Finally, 78.9% of the female students showed regular menstrual cycle.

**Table 3**: demonstrates that, there was a highly statistical significant difference between the results of post-intervention phase compared to pre-intervention phase in favors of post-intervention regarding all items of female nursing students' knowledge about dysmenorrhea ($p \leq 0.001$).

**Figure 1**: shows that, 39.5% of female nursing students had adequate total knowledge score and 60.5% of female nursing students had in adequate total knowledge score regarding dysmenorrhea at pre-intervention phase compared to 81.6% and 18.4%

at 4 weeks post-intervention and 84.2% and 15.8% at 8 weeks post-intervention respectively.

**Table 4**: demonstrates that, there was a highly statistical significant difference between mean score of female nursing student's menstrual pain at pre-intervention phase, 4 Weeks post intervention and 8 Weeks post intervention in favors of post-intervention ($P \leq 0.001$). In which the mean menstrual pain score decreased from 7.03±2.44 at pre-intervention to 4.86±2.32 at 4 weeks post-intervention to 4.36±1.92 at 8 weeks post-intervention.

**Table 5**: demonstrates that, there was a highly statistical significant difference between the total mean score of female nursing student's depression at pre-intervention phase, 4 Weeks post intervention and 8 Weeks post intervention in favour of post-intervention ($P \leq 0.001$). In which the mean pain score decreased from 23.50±4.46 at pre-intervention to 16.50±6.21 at 4 weeks post-intervention to 14.13±5.63 at 8 weeks post-intervention.

**Figure 2**: shows that, 61.8% of female nursing students had severe depression at pre-intervention phase compared to 22.4% and 13.2% of female nursing students had severe depression at 4 weeks post-intervention and at 8 weeks post-intervention respectively.

**Table 6**: demonstrates that, there was a highly statistical significant difference between the total mean score of female nursing student's sleep quality at pre-intervention phase, 4 Weeks post intervention and 8 Weeks post intervention in favors of post-intervention phase ($P \leq 0.001$). In which the mean sleep quality score decreased from 15.55±5.36 at pre-intervention to 10.26±5.25 at 4 weeks post-intervention to 8.86±5.23 at 8 weeks post-intervention phase.

**Figure 3**: shows that, 48.7% of female nursing students had poor sleep quality at pre-intervention phase compared to 15.8% and 6.6%of female nursing students had poor sleep quality at 4 weeks post-intervention and at 8 weeks post-intervention respectively.

**Table 7**: shows that, there was a highly statistically significant positive correlation between total pain score and total depression among female nursing students at pre- intervention, 4 weeks post-intervention and 8 weeks post- intervention phases ($P \leq 0.001$). On the other hand, there was a highly statistically significant negative correlation between total pain score and total sleep quality among female nursing students at pre- intervention, 4 weeks post-intervention and 8 weeks post- intervention phases ($P \leq 0.001$). This indicates that the less pain, the less depression level and the good sleep quality.

**Table 8**: shows that, there was a highly statistically significant negative correlation between total depression score and total sleep quality among female nursing students at pre-intervention, 4 weeks post-intervention and 8 weeks post- intervention phases ($P \leq 0.001$). This indicates less depression, good sleep quality.

**Table (1): Distribution of studied female nursing students according to personal characteristics (n=76)**

| Variables | No | % |
|---|---|---|
| **Age (in year)** | | |
| 17- | 11 | 14.5 |
| 18- | 50 | 65.8 |
| 19- | 15 | 19.7 |
| **Mean ±SD** | 18.05±0.58 | |
| **Marital status** | | |
| Single | 73 | 96.1 |
| Married | 3 | 3.9 |
| **Residence** | | |
| Rural | 43 | 56.6 |
| Urban | 33 | 43.4 |
| **Mothers' education** | | |
| Read and write | 4 | 5.2 |
| Basic education | 17 | 22.4 |
| Secondary education | 36 | 47.4 |
| University education | 19 | 25.0 |
| **Mothers' occupation** | | |
| Employee | 24 | 31.6 |
| Housewife | 52 | 68.4 |

**Table (2): Distribution of studied female nursing students according to menstrual history (n=76)**

| Variables | No | % |
|---|---|---|
| **Age at Menarche** | | |
| <11 years | 13 | 17.1 |
| 11-13 years | 45 | 59.2 |
| >13 years | 18 | 23.7 |
| **Duration of menstrual flow** | | |
| < 3 days | 17 | 22.4 |
| 3–7 days | 47 | 61.9 |
| >7 days | 12 | 15.7 |
| **Amount of blood flow** | | |
| 1 pad/day | 4 | 5.3 |
| 2–4 pads/day | 59 | 77.6 |
| ≥ 5 pads/day | 13 | 17.1 |
| **Length of menstrual cycle** | | |
| < 21 days | 2 | 2.6 |
| 21–35 days | 67 | 88.2 |
| >35 days | 7 | 9.2 |
| **Menstrual cycle regularity** | | |
| Yes | 60 | 78.9 |
| No | 16 | 21.1 |

**Table (3): Distribution of studied female nursing students' knowledge regarding dysmenorrhea at pre- intervention, 4 weeks post-intervention and 8 weeks post-intervention phases (n=76).**

| Knowledge Items | Before intervention | | 4 Weeks Post intervention | | 8 Weeks Post intervention | | $X_1^2$ (P-value) | $X_2^2$ (P-value) |
|---|---|---|---|---|---|---|---|---|
| | Correct answer | | Correct answer | | Correct answer | | | |
| | No | % | No | % | No | % | | |
| Definition of dysmenorrhea | 32 | 42.1 | 66 | 86.8 | 68 | 89.5 | 33.2 0.000** | 37.8 0.000** |
| Causes of dysmenorrhea | 27 | 35.5 | 61 | 80.3 | 60 | 78.9 | 31.1 0.000** | 29.2 0.000** |
| Types of dysmenorrhea | 15 | 19.7 | 65 | 85.5 | 66 | 86.8 | 65.9 0.000** | 68.7 0.000** |
| Risk factors of dysmenorrhea | 19 | 25.0 | 60 | 78.9 | 62 | 81.6 | 44.3 0.000** | 48.8 0.000** |
| Signs and symptoms of dysmenorrhea | 35 | 46.1 | 62 | 81.6 | 65 | 85.5 | 20.7 0.000** | 26.3 0.000** |
| Complications of dysmenorrhea | 20 | 26.3 | 54 | 71.1 | 59 | 77.6 | 30.4 0.000** | 40.0 0.000** |
| Management of dysmenorrhea | 24 | 31.6 | 52 | 68.4 | 57 | 75.0 | 20.6 0.000** | 23.7 0.000** |

**** Highly statistically significance P-value ≤0.001.**

$X1^2$ Comparison between pre-intervention and 4 weeks Post intervention

$X1^2$ Comparison between pre-intervention and 8 weeks Post intervention

**Figure 1: Distribution of female nursing students regarding their total knowledge score about dysmenorrhea at pre- intervention, 4 weeks post-intervention and 8 weeks post- intervention phases (n=76).**

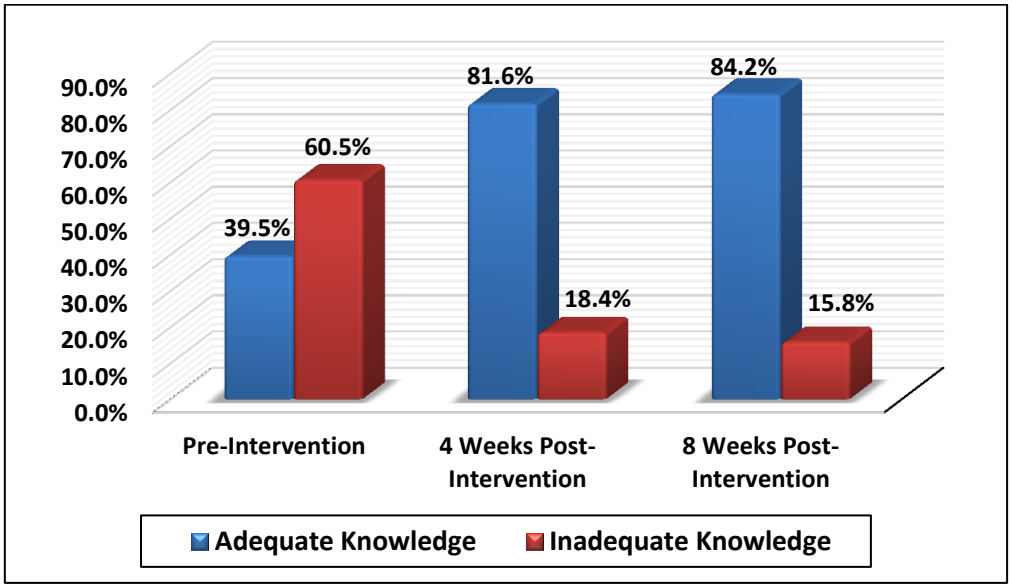

**Table (4): Distribution of studied female nursing students according to severity of menstrual pain at pre- intervention, 4 weeks post-intervention and 8 weeks post-intervention phases (n=76).**

| Severity of Pain | Pre-intervention | | 4 Weeks post intervention | | 8 Weeks post intervention | | $X_2^2$ (P-value) | $X_1^2$ (P-value) |
|---|---|---|---|---|---|---|---|---|
| | No | % | No | % | No | % | | |
| Mild pain | 9 | 11.8 | 22 | 28.9 | 24 | 31.6 | 32.5 0.000** | 50.6 0.000** |
| Moderate pain | 15 | 19.7 | 37 | 48.7 | 43 | 56.6 | | |
| Severe pain | 52 | 68.4 | 17 | 22.4 | 9 | 11.8 | | |
| **Mean ±SD** | 7.03±2.44 | | 4.86±2.32 | | 4.36±1.92 | | t= 12.9 0.000** | t= 16.1 0.000** |

$x^2$ =chi square test t= paird t test ** Highly statistical significant difference (P ≤ 0.001)

**Table (5): Mean scores of depression among female nursing students at pre-intervention, 4 weeks post-intervention and 8 weeks post- intervention phases (n=76).**

| Depression Items | Range of possible score | Pre-intervention | 4 Weeks post intervention | 8 Weeks post intervention | Paird t test 1 P-value | Paird t test 2 P-value |
|---|---|---|---|---|---|---|
| | | Mean ± SD | Mean ± SD | Mean ± SD | | |
| Little enjoyment in doing things | 0-3 | 2.51±0.62 | 1.76±0.70 | 1.42±0.80 | 15.0 0.000** | 11.6 0.000** |
| Feeling down, depressed or hapless | 0-3 | 2.59±0.61 | 1.84±0.67 | 1.56±0.82 | 15.0 0.000** | 11.1 0.000** |
| Difficulty initiating or maintaining sleep | 0-3 | 2.65±0.50 | 1.88±0.74 | 1.63±0.84 | 10.4 0.000** | 10.3 0.000** |
| feeling fatigue or lack of energy | 0-3 | 2.73±0.52 | 1.78±0.78 | 1.48±0.80 | 11.9 0.000** | 13.3 0.000** |
| Poor appetite or overeating | 0-3 | 2.60±0.56 | 1.88±0.76 | 1.61±0.79 | 10.8 0.000** | 11.1 0.000** |
| Feeling bad about yourself or that you are a failure | 0-3 | 2.56±0.69 | 1.76±0.79 | 1.51±0.88 | 10.3 0.000** | 10.1 0.000** |
| Difficulty focusing on things, as reading newspapers or watching television. | 0-3 | 2.65±0.55 | 1.89±0.79 | 1.65±0.85 | 9.14 0.000** | 9.74 0.000** |
| Moving or speaking so slowly that other people could have noticed | 0-3 | 2.56±0.57 | 1.80±0.74 | 1.61±0.83 | 9.32 0.000** | 9.25 0.000** |
| Thoughts that you would be better off dead, or causing harm to oneself. | 0-3 | 2.60±0.51 | 1.88±0.79 | 1.61±0.87 | 9.20 0.000** | 9.54 0.000** |
| **Overall Score** | **0-27** | **23.50±4.46** | **16.50±6.21** | **14.13±5.63** | **15.46 0.000**** | **16.27 0.000**** |

** Highly statistical significant difference (P ≤ 0.001)

Paird t1 Comparison pre-intervention and 4 weeks post-intervention

Paird t2 Comparison pre-intervention and 8 weeks post-intervention

**Figure 2: Distribution of female nursing students regarding their total depression score at pre- intervention, 4 weeks post-intervention and 8 weeks post- intervention phases (n=76).**

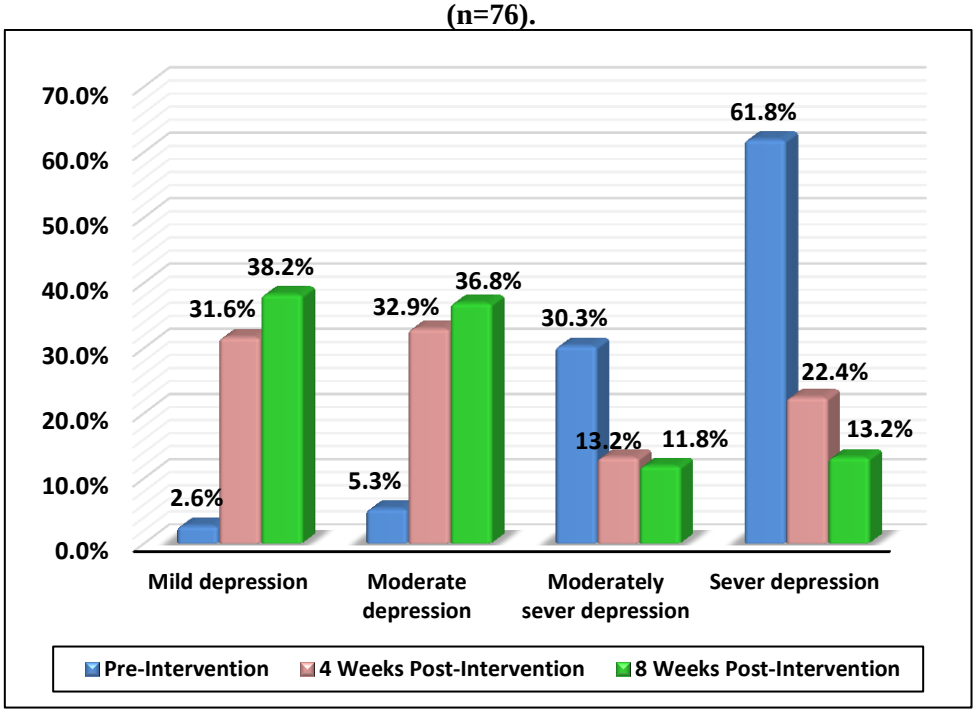


**Table (6): Mean scores of sleep quality among female nursing students at pre-intervention, 4 weeks post-intervention and 8 weeks post- intervention phases (n=76).**

| Dimensions | Range of possible score | Pre-intervention Mean ± SD | 4 Weeks post intervention Mean ± SD | 8 Weeks post intervention Mean ± SD | Paird t test 1 P-value | Paird t test 2 P-value |
|---|---|---|---|---|---|---|
| Total Subjective sleep quality | 0-3 | 2.19±0.86 | 1.55±0.92 | 1.39±0.88 | 9.29 0.000** | 10.3 0.000** |
| Total Sleep latency | 0-3 | 2.21±0.78 | 1.38±0.84 | 1.19±0.80 | 11.2 0.000** | 13.7 0.000** |
| Total Sleep duration | 0-3 | 2.09±0.98 | 1.48±0.99 | 1.27±0.98 | 8.05 0.000** | 8.58 0.000** |
| Total Sleep efficiency | 0-3 | 2.36±0.74 | 1.40±0.86 | 1.21±0.85 | 11.07 0.000** | 13.1 0.000** |
| Total Sleep disturbance | 0-3 | 2.17±0.80 | 1.53±0.91 | 1.30±0.89 | 8.21 0.000** | 10.03 0.000** |
| Total Use of sleep medication | 0-3 | 2.34±0.72 | 1.57±0.85 | 1.32±0.82 | 10.9 0.000** | 11.9 0.000** |
| Total Daytime dysfunction | 0-3 | 2.17±0.94 | 1.31±0.83 | 1.15±0.81 | 10.03 0.000** | 11.94 0.000** |
| **Overall Score** | 0-21 | 15.55±5.36 | 10.26±5.25 | 8.86±5.23 | 14.64 0.000** | 14.80 0.000** |

** Highly statistical significant difference ($P \leq 0.001$)

Paird t1 Comparison pre-intervention and 4 weeks post-intervention

Paird t2 Comparison pre-intervention and 8 weeks post-intervention

**Figure 3: Distribution of female nursing students regarding their total sleep quality at pre- intervention, 4 weeks post-intervention and 8 weeks post- intervention phases (n=76).**

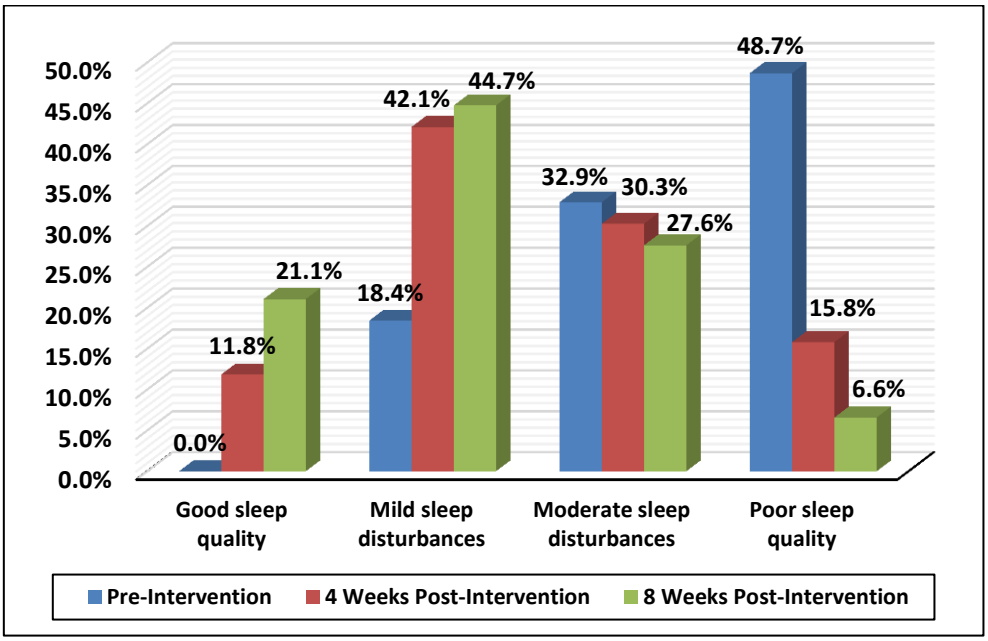


**Table (7): Correlation between total pain score, total depression score and total sleep quality score among female nursing students at pre- intervention, 4 weeks post-intervention and 8 weeks post- intervention phases (n=76).**

| Variables | Total pain score | | | | | |
|---|---|---|---|---|---|---|
| | Pre-intervention | | 4 Weeks post intervention | | 8 Weeks post intervention | |
| | r | P value | r | P value | r | P value |
| Total depression | 0.421 | .000** | 0.509 | .000** | 0.523 | .000** |
| Total sleep quality | -0.472- | .000** | -0.491- | .000** | -0.501- | .000** |

**A high statistical significant difference (P ≤ 0.001)

**Table (8): Correlation between total depression score and total sleep quality score among female nursing students at pre- intervention, 4 weeks post-intervention and 8 weeks post- intervention phases (n=76).**

| Variables | Total depression score | | | | | |
|---|---|---|---|---|---|---|
| | Pre-intervention | | 4 Weeks post intervention | | 8 Weeks post intervention | |
| | r | P value | r | P value | r | P value |
| Total sleep quality | -0.503- | .000** | -0.554- | .000** | -0.571- | .000** |

**A high statistical significant difference (P ≤ 0.001)

**Discussion:**

Nearly half of women in their reproductive years' experience menstrual cramps, with 10% facing severe dysmenorrhea, leading to the disruption of one to three days of their monthly lives. The main symptom of primary dysmenorrhea is lower abdominal cramps and pain that spreads to the inner thigh and usually begins several hours before the start of menstruation. This condition can persist for anywhere between twelve to seventy-two hours. More than half of those affected also experience symptoms that affect the entire body. While the precise reason behind primary dysmenorrhea is still unknown, it has been determined that prostaglandin activity largely contributes to the development of its symptoms (Shaba and Manimozhi, 2023).

The current research aimed to evaluate the effect of William's flexion exercises on menstrual pain, depression and sleep quality among nursing students with primary dysmenorrhea.

Concerning personal characteristics, the results of current research revealed that, less than two thirds of the female students were in the age group of 18 - <19 years old with an average age of 18.05±0.58 years. Also, majority of them were single. As well as, more than half of the female students were lived in a rural area. Moreover, less than half of female nursing students had mothers with secondary education and more than two thirds of their mothers were house wife.

The findings mentioned above matched with El-Kholy and Shalaby, (2022), who discovered that the average age of the participants in the study group was 18.41±0.79 years, while it was 18.52±0.63 years in the control group. Moreover, it was noted that over half (56% and 54%, respectively) of the study and control groups were born in rural areas. Similarly, the current findings aligned with Awad et al. (2019), who found that adolescent girls included in the study indicated that over a third of them were in 1st grade, approximately two-fifths of their mothers had secondary education, and less than three-quarters of their mothers were unemployed.

Regarding the history of menstruation, the current research findings clarified that, about three fifth of the female nursing students had their menarche at the age group of 11-13 years and that the duration of menstrual flow for more than three fifth of them ranged from 3 to 7 days. The amount of blood flow for more than three quarters of the female students was 2–4 pads/day and the length of the menstrual cycle for the most of them was 21–35 days. Finally, more than three quarters of the female students showed regular menstrual cycle.

These findings align with the research conducted by Elsawy et al., (2023), who reported that 68% of the adolescent students belong to the age of menarche 13-14 years. Total days of flow were within 5- 6 days among 66% of the adolescent students. As regard the interval of the menstrual

cycle, the majority of the adolescent students (92%) had an interval from 28–30 days and 80% of them had moderate menstrual flow (2-3 pads/day). Furthermore, Mammo et al., (2022), discovered that 67.6% of the participants, totaling 478 individuals, experienced menarche between the ages of 13 and 14, with an average age of menarche at 13.39 years. A majority of 56.3% (398 individuals) reported a menstrual duration lasting between 3 and 7 days, while an overwhelming 80.3% (568 individuals) reported a normal amount of menstrual flow. El-Kurdy et al. (2020), also found similar results, indicating that half of the blind adolescent girls studied began menstruating between the ages of 12 and 14, with over half experiencing menstrual cycles lasting more than 30 days and menstrual flow lasting 5 to 7 days.

Concerning female nursing students' knowledge regarding dysmenorrhea the current results revealed that, there was a highly statistical significant difference between the results of post-intervention phase compared to pre-intervention phase in favour of post-intervention phase regarding all items of female nursing students' knowledge about dysmenorrhea. In addition, the results showed that about two fifth of the female nursing students had adequate total knowledge score at pre-intervention phase compared to more than four fifth of them had adequate total knowledge score at 4 weeks and 8 weeks post-intervention. Inadequate knowledge among nursing students about dysmenorrhea before the intervention may due to the fact that nearly half of the students' mothers had secondary level of education, and more than two-thirds of the mothers were housewives, so they were unable to provide their daughters with the necessary information about dysmenorrhea. Conversely, the increase in overall knowledge score following the intervention could be attributed to the fact that the subject matter was deemed crucial and delicate by the nursing students, leading to high levels of interest and satisfaction during the educational sessions.

The results mentioned above were consistent with the findings of Shaba and Manimozhi (2023), who reported that the majority of students had low pretest knowledge of menstruation and dysmenorrhea, but their knowledge significantly increased after participating in an educational program. Similarly, Al Ajeel, et al. (2020), also found that health education led to improved knowledge and self-care among Arabic schoolgirls with primary dysmenorrhea. The study showed a significant difference in knowledge scores between the pretest and posttest in the experimental group.

Concerning menstrual pain among female nursing students with primary dysmenorrhea; the results of the current study revealed that, there was a highly statistical significant difference between mean score of female nursing student's pain at pre-intervention phase, 4 Weeks post intervention and 8 Weeks post intervention in favor of post-intervention. In which the mean pain score decreased from 7.03±2.44 at pre-intervention to 4.86±2.32 at 4

weeks post-intervention to 4.36±1.92 at 8 weeks post-intervention. These results can be explained by the fact that practicing William's flexion exercise can stretch the back and thigh muscles, and cause contractions in the abdominal muscles, which leads to increased abdominal muscle strength, which is believed to reduce back and stomach pain. Additionally, physical activity can enhance oxygen levels and promote lymphatic drainage to improve muscle flexibility and preserve the elasticity of body tissues. Furthermore, the release of ß-endorphin during exercise can impact dopamine release, triggering feelings of pleasure and satisfaction in the brain while reducing pain perception.

According to a multitude of specialists, this enhancement can be attributed to the rise in blood circulation and metabolism within the uterus during physical exercise, resulting in a notable reduction of dysmenorrhea symptoms (Saleh et al., 2019). Correspondingly, Kannan et al. (2019), discovered that engaging in physical activity leads to an overall surge in anti-inflammatory cytokines, which play a crucial role in alleviating pain. As mentioned in the study by Gmoorthy et al., (2018), an increase in metabolism is essential for reducing these symptoms. Shirvani et al., (2018), further elaborate that this enhancement in pelvic blood flow helps in preventing the build-up of prostaglandins. In simpler terms, as highlighted by Dehnavi et al., (2018), physical activity can facilitate the quicker removal of waste and prostaglandins from the uterus.

The findings of the present study align with the research conducted by Purwandani and Anggraini, (2023), who observed that the mean intensity of menstrual pain in young women decreased from 5.70 to 2.85 after engaging in William's Flexion Exercise technique for approximately 7-10 minutes. The statistical analysis confirmed a significant reduction in the intensity of menstrual pain among young women following the implementation of William's Flexion Exercise (p value = 0.000). The findings were consistent with the study conducted by Anggreini et al., (2022), which indicated that the William's Flexion Exercise technique had an impact on the severity of menstrual pain. Prior to implementing the William's Flexion Exercise technique, female students reported experiencing dysmenorrhea at a level of 6, whereas after the technique was performed, the pain caused by dysmenorrhea decreased to a level of 2.

Abidin et al., (2020), conducted additional research that yielded comparable findings, indicating that William's Flexion Exercise had a significant impact on alleviating menstrual pain. Prior to receiving instruction on the William's Flexion Exercise technique, students reported experiencing menstrual pain at a level of 6. However, following therapy utilizing the William's Flexion Exercise technique, the intensity of pain decreased to a level of 3. Furthermore, the findings of this investigation were consistent with the research conducted by Oktaviani and Lestari (2017). Their study involved

26 female students and demonstrated that undergoing William Flexion training effectively alleviated the severity of menstrual pain.

The above-mentioned results supported the first study hypothesis which stated that nursing students will show less menstrual pain after practiced William's flexion exercise.

During the premenstrual phase, low levels of serotonin can contribute to feelings of depression, anxiety, and mood swings. Serotonin, often referred to as the "happy hormone," decreases before menstruation begins, leading to symptoms like irritability and mood disorders. According to the monoamine hypothesis, engaging in exercise can enhance the presence of monoamines such as serotonin, epinephrine, and dopamine. Consequently, exercise promotes both physical well-being and psychological health (Gmoorthy et al., 2018).

Regarding depression among female nursing students with primary dysmenorrhea; the results of the current study revealed that a highly statistical significant difference between the total mean score of female nursing student's depression at pre-intervention phase, 4 Weeks post intervention and 8 Weeks post intervention in favors of post-intervention. In which the mean pain score decreased from 23.50±4.46 at pre-intervention to 16.50±6.21 at 4 weeks post-intervention to 14.13±5.63 at 8 weeks post-intervention. In addition, the results showed that less than two thirds of female nursing students had severe depression at pre-intervention phase compared to less than one quarter and more than one tenth of female nursing students had severe depression at 4 weeks post-intervention and at 8 weeks post-intervention respectively. The findings indicate that regular aerobic exercise offers a wide range of benefits, including enhanced cardiovascular capacity, improved bone density, and decreased stress levels. These positive effects lead to a reduction in depression, as well as improvements in mood, behavior, and concentration. Additionally, physical exercise has been shown to lower sympathetic activity, which in turn decreases in the short to medium term. Furthermore, it boosts parasympathetic activity during rest, resulting in a reduction of menstrual symptoms.

The results of Ji et al., (2022), were consistent with our findings, indicating that a 6-week exercise intervention can enhance anxiety levels, sleep quality, and reduce symptoms of depression among college students. Similarly, Kleppang et al., (2018), also found that regular exercise among adolescents was associated with a decreased likelihood of experiencing depressive symptoms. Furthermore, other research, such as McDowell et al., (2017), in a large-scale study involving adolescents aged 12-18, showed that those who participate in moderate to high levels of physical activity (60 minutes) for at least 3-7 days per week also reported decreased levels of anxiety and depressive symptoms.

The above-mentioned results supported the second study hypothesis which stated that nursing students will

show less depression level after practiced William's flexion exercise

Inadequate sleep, high levels of stress, anxiety, and depression have been linked to dysmenorrhea. While the exact causal relationship remains unclear, these psychological factors and dysmenorrhea may influence each other, creating a cycle of negative impact (Bajalan et al., 2020).

Regarding sleep quality among female nursing students with primary dysmenorrhea; the results of the current study revealed that, there was a highly statistical significant difference between the total mean score of female nursing student's sleep quality at pre-intervention phase, 4 Weeks post intervention and 8 Weeks post intervention in favour of post-intervention phase. In which the mean sleep quality score decreased from 15.55±5.36 at pre-intervention to 10.26±5.25 at 4 weeks post-intervention to 8.86±5.23 at 8 weeks post-intervention phase. In addition, less than half of female nursing students had poor sleep quality at pre-intervention phase compared to less than one fifth and less than one tenth of female nursing students had poor sleep quality at 4 weeks post-intervention and at 8 weeks post-intervention phase respectively. The reason behind these findings can be attributed to the fact that engaging in William's flexion exercises enhances the circulation of blood to the muscles being exercised. Consequently, this results in a larger surface area of open capillaries in the working muscles, leading to a reduction in muscle tension and ultimately improving the quality of sleep.

The results of this study align with the findings of Kirmizigil and Demiralp, (2020), indicating that combining exercise therapy with other treatments is an effective approach in managing symptoms of primary dysmenorrhea. The exercise group engaged in physical activity three times a week for a duration of eight weeks. Pain severity was assessed using the Visual Analog Scale, while sleep quality was evaluated through the Pittsburgh Sleep Quality Index. Significant improvements were observed in both pain severity and sleep quality after the eight-week period. Additionally, the outcomes are consistent with the research conducted by Aibar-Almazan et al., (2019), which demonstrated a notable enhancement in sleep quality among women in the exercise group compared to those in the control group following the exercise program. Furthermore, Kovacevic et al., (2017), highlighted the effectiveness of strengthening exercises on sleep quality and recommended a combination of aerobic and strengthening exercises for optimal results.

The above-mentioned results supported the third study hypothesis which stated that nursing students will show high sleep quality after practiced William's flexion exercise

Concerning correlation between studied variables, the results of the current study revealed that, there was a highly statistically significant positive correlation between total pain score and total depression among female

nursing students at pre- intervention, 4 weeks post-intervention and 8 weeks post- intervention phases. On the other hand, there was a highly statistically significant negative correlation between total pain score and total sleep quality among female nursing students at pre- intervention, 4 weeks post-intervention and 8 weeks post-intervention phases. This indicates that the less pain, the less depression level and the good sleep quality. Wang et al., (2019), concurred with these findings, indicating a negative association between pain and sleep quality. Additionally, they discovered a connection between sleep and menstrual pain. Similarly, Faramarzi and Salmalian (2017), supported these results by demonstrating a correlation between neuroticism and menstrual pain. Furthermore, individuals experiencing menstrual pain reported lower levels of social support compared to those without menstrual pain.

The current study findings reported that a highly statistically significant negative correlation between total depression score and total sleep quality among female nursing students at pre-intervention, 4 weeks post-intervention and 8 weeks post- intervention phases. This indicates that the less depression, the good sleep quality. The results align with the findings of Uchida et al. (2017), which indicated that engaging in resistance training could enhance sleep quality through the reduction of depression or anxiety levels and alleviation of pain.

Finally, the current research demonstrated the fact that practicing William flexion exercises are effective in reducing pain severity and depression level as well as improving sleep quality among female nursing students with primary dysmenorrhea. Thus education and encouragement of those students about the importance of William' flexion exercises are essential.

## Conclusion

Based on the findings of the current research; it was concluded that research hypotheses were supported and the implementation of William' flexion exercise was effective in reducing level of menstrual cramps, depression level and improving quality of sleep among female nursing students with primary dysmenorrhea. Additionally, the results of the current study revealed that, there was a highly statistically significant positive correlation between total pain score and total depression among female nursing students at pre- intervention, 4 weeks post-intervention and 8 weeks post- intervention phases. On the other hand, there was a highly statistically significant negative correlation between total pain score and total sleep quality among female nursing students at pre- intervention, 4 weeks post-intervention and 8 weeks post-intervention phases.

## Recommendations:

Recommendations derived from this research are as follows:

**1)** Integrating William's flexion exercises into nursing health education and curriculum can serve as a valuable complementary and

alternative therapy for alleviating primary dysmenorrhea.

2) Educational initiatives should be implemented to enhance the knowledge of teenage girls regarding dysmenorrhea, as well as the significance of prompt referral.

**Further researches:**

1) A training program should be designed for nurses to enhance their skills in implementing William's flexion exercises as an effective method for reducing dysmenorrhea.
2) It is advisable to conduct a replication of the study using a large representative probability sample in order to enhance the generalizability of the findings.

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