

Effect of Foot Massage on Physiological Indicators, Fatigue, and Pain among Children undergoing Chemotherapy

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Abstract

Background: Foot massage appears to be effective, affordable, adaptable, and simple to use. Foot massage appears to be effective in reducing pain, fatigue, improving physiological indicators and sleep patterns among children undergoing chemotherapy. **Aim:** To determine the effect of foot massage on physiological indicators, fatigue, and pain among children undergoing chemotherapy. **Subjects and Methods:** **Design:** A quasi-experimental design was used to conduct this study. **Setting:** The study was conducted at Oncology Institution in Sohag City and Pediatric Oncology Department at Sohag University Hospital. **Subject:** A purposive sampling technique was used to choose a sample of 100 children undergoing chemotherapy who were assigned into two groups, with 50 children undergoing chemotherapy in each group (the intervention and control groups). **Tools:** Three tools were used for data collection (I) a structured interview questionnaire, (II) a fatigue assessment scale, and (III) an OUCHER pain measurement tool. **Results:** The current study revealed that the majority of children in the intervention group experienced mild pain with ($p = 0.002$) and improving physiological indicators [blood pressure ($p = 0.002$) and heart rate ($p = 0.003$). Additionally, there were highly statistically significant differences regarding the scores of fatigues and pain in the intervention group as compared to the control group pain with ($P = <0.05$). **Conclusion:** Foot massage was effective in improving physiological indicators and reducing fatigue levels and pain among children undergoing chemotherapy. **Recommendations:** Foot reflexology could be used as a complementary treatment along with conventional therapies among children undergoing chemotherapy as a simple and applicable strategy to improve physiological indicators and reduce fatigue and pain levels.

Keywords: Children undergoing chemotherapy, Foot massage, Fatigue, Pain, Physiological indicators.

Introduction:

Childhood cancer is still a big problem because; children with cancer can't be treated exactly like adult with cancers where most federal research funding goes. Current treatments are toxic, affect a child's development, and can be decades old. To treat childhood cancer in the best way possible, medical staff must create a specialized treatment just for kids. The causes of childhood cancer are largely unknown (Kashaninia, 2016).

Cancer is treated with chemotherapy; chemotherapy is given in cycles, with each period of treatment followed by a rest period to give the body time to recover from the effects

of the drugs. Cycles are most often 2 or 3 weeks long. Chemotherapy begins on the first day of each cycle, but the schedule varies depending on the drugs used (American Cancer Society, 2020). Moreover, chemotherapeutic agents can be divided into several classes based on the mechanism of action, chemical structure, biological source, or effect on the cell cycle (Heinemann and Boyce, 2017).

Chemotherapy is a long-term treatment and leads to many side effects. Acute side effects after chemotherapy including nausea, vomiting, mucositis, diarrhea, constipation, alopecia, rash, fatigue, pain, dark skin, nail changes, ocular toxicity arrhythmia, pericarditis, myocarditis, left ventricular

changes, hypotension, pneumonitis, electrolyte disturbances, leukoencephalopathy, and acute pancreatitis (**Worldwide organization, 2019**).

Fatigue is recognized as one of the most common and distressing symptoms experienced by pediatrics with cancer. The prevalence of fatigue during cancer treatment ranges from 25 to 99%. Fatigue makes a child feel more tired than usual and could interfere with daily life activities and sleep. Fatigue may be caused by anemia, specific chemotherapy drugs, poor appetite, or depression. It may also be related to toxic substances that are made in the body when cancer cells break down and die. Fatigue can happen within days after a chemotherapy treatment and can last long after treatment ends. Causes of fatigue in children with cancer could be associated with the hypermetabolic state associated with the growth of the tumor, competition for nutrients between the organism and the tumor, harmful effects of the chemotherapy and radiotherapy, inadequate nutritional intake, associated with nausea and vomiting due to the antineoplastic therapy, anemia, sleep disorders, uncertainty about the future; fear of death and mutilations (**Nunes et al., 2019**).

Fatigue is one of the most common and debilitating side effects of cancer diagnosis and treatment. Generalized weakness, poor mental concentration, insomnia or hypersomnia, and emotional changes are among clinical symptoms of fatigue that significantly reduce patients with cancer overall quality of life during and after treatment. Although the etiology of the link between cancer and fatigue has yet to be determined, physiological, biochemical, and psychological abnormalities appear to play a role. Several strategies in the management of cancer-related fatigue have been examined due to their complex character (**Armstrong et al., 2018**).

Some chemotherapy drugs could cause painful side effects, such as aching in the muscles and joints, headaches, and stomach pains. Pain may be felt as a burning, numbness, tingling, or shooting pains in the hands and feet (called peripheral nerve damage). This type of pain can last long after treatment ends. The healthcare team will recommend what

medicines should be use to relieve the pain (**Macmillan Cancer Support, 2021**).

There are a variety of pharmacological and non-pharmacological therapies available to help patients achieve optimal pain management; however, each patient's reaction is unique. The current gold standard treatment for acute postoperative pain management is pain medications. Alternative modalities and non-pharmacological techniques for pain and fatigue management, such as massage, are gaining popularity around the world as a way to avoid the negative side effects of medications (**Van et al., 2016**).

In all alternative therapies, foot massage is one of the most common types of massage. The ability to help with pain relief it's a technique that could be a little uncomfortable at first, but it's usually pretty calming. The Foot Massage activates big primary afferents by stimulating cutaneous mechanoreceptors. They release GABA and endorphins, which block neurotransmitters released by primary nociceptive neurons and cause depressive reactions in the pain pathway's receptive area. Massage produces tactile stimulation that goes through big diameter fibers. These fibers also transmit data at a faster rate. Massage treatment improves circulation, allowing the body to feel more relaxed and invigorated while also reducing muscle tension and pain, resulting in improved overall health and well-being (**Chanif et al., 2019**).

The new emerging measures in pain management and reducing fatigue are complementary therapy which includes cutaneous stimulation, massage, cold and hot therapies, transcutaneous electrical nerve stimulation (TENS), relaxation techniques, hypnosis, and some physiological symptoms in children, and there were statistically significant differences between the foot reflexology group and the control group concerning all physiological indicators ($p < 0.05$) (**Sabzevari, 2020**).

Among them, massage therapy has a long history in different cultures around the world. Today, people use different types of massage therapy for a variety of health promotions. Massage is a natural way of light touching, rubbing the entire body gives comfort both

physically and psychologically and gives general relaxation in the body, reducing pain perception; reduce fatigue, by affecting the locomotor system and the nervous system as well as the cardiovascular system (**Massage - Physiopedia, 2021**)

Nurses are critical play effective role in providing counseling, education, and advice to ensure the technique's success. Also, play an important role in assisting patients to minimize their discomfort and sleep better. Non-pharmacological treatment strategies and approaches include pharmaceutical therapy, information, distraction, attention focusing, and relaxing treatments (**Esther Lilly & Dakshayani, 2018**).

Significance of the study:

The use of CAM therapies increases the patient's ability to adapt and reduce their anxiety, and fatigue, and can be easily used by children. Additionally, it is accompanied by easy acceptance and cooperation between children and parents. Among these methods, foot reflexology is a type of massage, which is one of the most important complementary therapies used among nurses (**Huang et al., 2021**). Different studies have shown that reflexology also, improves cancer pain (**Singh & Chaturvedi, 2019**).

Massage is a stand-alone nursing intervention that could be used to help patients who are in pain. Massage is simple to do, inexpensive, and requires no special equipment. It might be incorporated into routine nursing tasks (**Bauer et al., 2019**). Fatigue and pain are the most common side effects of chemotherapy. It adversely affects not only a child's sense of well-being but also his/her daily performance, activities, relationships with family, friends, and tolerance to treatment (**Karagozolu & Kahve, 2018**). So, this study was conducted to determine the effect of foot massage on physiological indicators, fatigue, and pain among children undergoing chemotherapy.

Aim of the study:

This study aimed to determine the effect of foot massage on physiological indicators, fatigue, and pain among children undergoing chemotherapy through:

- Assessing physiological indicators among children undergoing chemotherapy.
- Assessing fatigue levels among children undergoing chemotherapy.
- Assessing pain levels among children undergoing chemotherapy.
- Evaluating the effect of foot massage on physiological indicators, sleep patterns, fatigue, and pain among children undergoing chemotherapy

Research hypothesis:

H₁.The children undergoing chemotherapy who receive foot massage will experience little pain and fatigue than those who do not.

H₁.The children undergoing chemotherapy who receive foot massage will experience improvement in physiological indicators than those who do not.

Subjects and Methods:

Research design:

A quasi-experimental research design was used to conduct this study. It is used for establishing the cause-and-effect of the relation between the independent and dependent variable.

Setting:

The study was conducted at the Oncology Institution in Sohag City, at Sohag Governorate, EGYPT. It consists of two buildings, an adult and pediatric building. The pediatric building include unit for receiving chemotherapy on the second floor. While children with leukemia ward on the third floor of the pediatric building which is divided into two parts. Part, one consists of five rooms, each room containing two beds, two commodes, and a bathroom. Part two consists of six rooms each room contained two beds, two commodes, and a bathroom. This setting was selected because of the high prevalence of children undergoing chemotherapy in the selected settings and also, it serves the biggest region of the population from both rural and urban areas. Additionally, the Pediatric Oncology Department at Sohag University Hospital is on the second floor.

Sample:

A simple random sampling technique was used to select the participants. A purposive sample of 100 children undergoing chemotherapy was recruited in this study; the studied children were assigned into two groups, with 50 children undergoing chemotherapy in each group (the intervention and control groups). The randomization achieved by asking each child to pick cards with numbers one and two were given to the participants. Children selecting number one were placed in the intervention group, while those selecting two were placed in the control group. The intervention group receives a foot massage, and the control group received routine care from the department. The children included in this study were selected according to the following:

Inclusion criteria were:

- Aged from 6–12 years old.
- Healthy feet
- Agree to participate in the study

Exclusion criteria were:

- Unwillingness to participate
- Foot problems
- History of chronic pain
- Injury in extremities
- Child restlessness, seizures, heart disease, and acute respiratory disease

Sample size calculation:

The sample size was calculated based on considering the level of significance of power analysis of $0.95(\beta=1-0.95=0.5)$ at alpha .05 (one-sided) with a large effect size (0.5) was used as the significance, 0.001 was used as the high significance.

Tools of data collection:

Three tools were used in this study as follows:

Tool (I) A structured interview questionnaire: It was developed by the researchers after reviewing the relevant related literature (**Worldwide organization, 2019**) and **American Cancer Society, 2021**); It was composed of two parts:

Part (1): It included demographic data which consisted of 5 items related to age, gender,

educational level, residence, and duration of the disease.

Part (2): It included the physiological indicators of the children; it consisted of 3 items about heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP).

Tool (II): Fatigue assessment scale:

This tool was adopted from **De Kleijn et al., (2011)**, it was a self-developed rating scale consisting of 10 items (which assess the fatigue level of individuals during various activities in a week in terms of physical, social, psychological, and spiritual domains and their relation with the day time). Scores ranged from 0 (no fatigue) to 10 (worst fatigue) with a total score ranging from 0 to 100. No fatigue (0), very little (1-9), mild (10-30), moderate (31-60), severe (61-80), worst denotes (81-100).

Tool (III): OUCHER pain measurement tool:

The OUCHER is a standard pain instrument that is suitable for children. In this tool, photographs of normal and upset faces of children are used, which are taken of children while experiencing real pain in the hospital. This tool includes six pictures of children demonstrating different degrees of pain and is placed vertically from the least to the most severe pain from the bottom up, having scores of 1–6, where 1 indicates no pain and 6 indicates very severe pain. For children who are unable to count to 100, a score of 1 indicates no pain; 2, mild pain; 3 and 4, moderate pain; 5, severe pain; and 6, the most severe pain experienced by the child. The numbers 0–100 is also placed to the left of the photographs. The numerical value is for children who can count with zero being painless; 1–29, mild pain; 30–69, moderate pain; 70–99, severe pain; and 100, the most severe pain possible. In the present study, a numerical format of 0–100 Oucher tools was used (**Beyer et al., 1992**).

Tools validity and reliability

The content validity of the tools is testing the tool clarity, comprehensiveness, appropriateness, and relevancy. The tools were reviewed by three experts: in the pediatric nursing field and two experts' professors in pediatric oncology. Modifications were made

according to the panel judgment to ensure clarity and content appropriateness for the internal consistency of the tools. The test-retest reliability was determined by using the same tools on the same participants under similar conditions on two or more occasions. Scores from repeated testing were compared using Cronbach's alpha coefficient method. Fatigue assessment scale reliability is considered reliable with Cronbach's alpha of 0.83 for the total score, and The OUCHER pain measurement tool reliability was ($r = 0.94$).

The Preparatory Phase:

Administrative design:

Administrative permission was obtained through an issued letter from Sohag University Directors of the previously selected department to achieve this study.

Ethical considerations:

Before beginning the study, the researchers met with the pediatric nursing directors of the chosen setting to explain the aim of the study and gain their cooperation. First, the objectives of the study were explained to the children's parents and informed consent was obtained to obtain their cooperation. They were informed that participation in the study was voluntary, and they were free to withdraw from the study at any time, without giving any reason. The participants were told that their information would be kept confidential and used for research purposes only.

The pilot study

It was conducted on 10% of the studies sample (10 children undergoing chemotherapy) of the total sample to assess the clarity and applicability of the tools and to identify any difficulties that may be faced during the actual study. In addition, the time needed to answer the tools were also estimated. To produce the final form of the tools, modifications were made. Children included in the pilot study were included in the study.

Fieldwork:

The researcher visited the previously selected settings two days/ a week from 9 am to 1 pm. They met the children individually and explain the aim of the study after introducing

herself to the participants. Data were collected within six months, from the beginning of July to the end of December 2019. Approximately, 50-60 minutes were taken to complete interview tools using face-to-face interviews.

Initially, the researcher gains the children's cooperation by creating a pleasant relationship with them by engaging in brief conversations. The researchers completed the questionnaires (structured interview questionnaire, fatigue assessment scale, PSQI, and the OUCHER pain measurement tools) were assessed for both the study and control group twice prior to the intervention, then assessed for the study group post the intervention, as well for the control group post receiving the routine hospital care.

• The fieldwork was achieved through the following sequences:

In the intervention group, a foot massage was performed by a researcher. Before the intervention, the researcher prepared the children and environment for the intervention. The demographic information questionnaire was completed before the foot massage.

The children were made to lie on their backs. A pillow was placed under their foot, and their trousers were pulled up to the knee. The researcher sat in a completely comfortable and relaxed position in front of the children. The researcher smeared his hand with a small amount of baby lotion with non-therapeutic properties. For general massage, the massage was initiated from the calf. The soles of the feet and toes were massaged successively for 2 min for relaxation. Special attention was paid to four important reflection points of the sole, namely the solar plexus, pituitary gland, heart, and liver. The solar plexus is located between the upper and middle third of the sole and the area between the heart and liver under the chest, which is mostly used as a reflection point for vital signs, while the pituitary gland is located in the middle of the big toe.

Each of the reflection points of the foot using the middle part of the first part of the index finger and the fleshy part of the toe of the researcher, with a pressure of 0.5 cm were massaged circularly; thus, one-third of the nail bed was white, without interrupting the contact

of the toes with the foot skin. The reflective massage was performed with constant pressure in the form of continuous and rotational clockwise movements in each part. After finishing one foot, the sole of the other foot was reflected in the same manner.

First, the massage was performed on the left foot and then on the right foot. A total of 10 min of reflexology massage was performed for each foot with a total of 20 min for both feet.

- Rotational friction movements, stretching, gripping, and flexing on diverse areas of the feet with focusing on a specific point were the main specialized massage. Friction is defined as deep, circular movements that attempt to rub tissue layers against each other to improve blood flow.

The following massage techniques were used:

- Effleurage was used to distribute the lubricant throughout the participants' feet by stroking them from toes to ankles.

- Use petrissage, a short, soft, and rapid movement, to squeeze and roll your feet, fingers, and toes.
- Tapotement was accomplished with short finger taps (i.e. thumping or percussion).
- Friction was used to rub the layers of tissues to promote blood flow.

To check the physiological parameters, the blood pressure of all children was measured in the right hand using a sphygmomanometer. The heartbeat was examined for 1 min to assess HR. After 20 min of massage, the child was transferred to the chemotherapy room.

Ten minutes after chemotherapy, the researcher assisted the child by observing their fatigue level, and pain and examining their physiological parameters. Simultaneously, the child's pain intensity was completed with the child's report using the Osher pain tool. The totality of the measures performed, and the examination of fatigue level, pain, and physiological features were performed once.

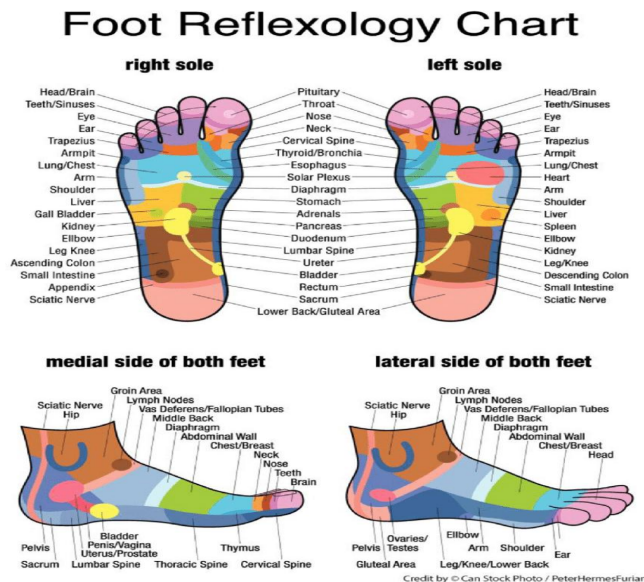


Fig (2): Foot Reflexology Chart

https://www.researchgate.net/figure/Foot-Reflexology-Chart-Credit-by-Can-Stock-Photo-Inc-Peter-Hermes-Furain-Permission_fig1_324785947/download

In the intervention group, foot reflexology was performed by a researcher with 5 years of experience. Simultaneous validity was used to obtain the correct determination of the reflection

points of the foot and how to apply pressure; thus, the method of work was approved by the acupuncturist and expert in reflexology. Before

the intervention, the researcher was trained by physical therapist.

In the control group, routine treatment and care were performed 20 min before chemotherapy according to the hospital protocol of care including drug administration such as analgesics to relieve pain and provide emotional support, and at specified times (10 min after chemotherapy) physiological indicators fatigue level, and pain were assessed as in the intervention group. This study was performed in a blinded manner. In this way, a research assistant who had the characteristics of a researcher was used to evaluate physiological parameters, fatigue level, and pain after the intervention.

Statistical analysis:

The data were analyzed using SPSS statistical software version 20. Continuous data were obtained before and after the massage for three days and expressed as mean standard deviation (SD). Categorical data were expressed using numbers and percentages. The independent t-test was used to investigate differences between the two groups, while the paired t-test was employed to investigate differences between each group before and after a massage session. Changes in pain physiological indicators, sleep quality, and fatigue levels were analyzed using a one-way repeated-measures analysis of variance (ANOVA). The Mann-Whitney test was used for variables that did not match the parametric assumptions. The chi-square test was used to evaluate the results. The link between the two variables was investigated using the chi-square test. The chi-square test was used to assess the relationship between two variables in the case of noncontiguous data. A P value of less than 0.05 was used to determine statistical significance.

Results:

As shown in **table 1** the mean age of the studied children was 7.08 ± 2.34 and 7.89 ± 2.86 years in the intervention group and control group respectively. Concerning gender, 62% of the studied children were boys in the intervention group compared to 60% in the control group. Regarding the level of education, it was observed that (54%) of the studied children in the intervention group were at the educational level from 1-3 compared to 58% in the control group. In the intervention group, the same table pointed

out that (72%) of the studied children were living in urban areas compared to 70% in the control group. There was no significant difference between the two groups concerning their demographic data. Regarding the duration of disease (60% and 62%) children have the disease for less than one year in both studied groups respectively.

Table 2 illustrates that the means of systolic blood pressure (SBP) and diastolic blood pressure (DBP) after intervention in the intervention group were 89.35 ± 16.67 mmHg and 57.87 ± 12.8 mm Hg, respectively. However, the means of SBP and DBP after intervention in the control group were 97.49 ± 14.27 mm Hg and 58.63 ± 10.32 mmHg, respectively. The independent t-test showed that the mean of SBP and DBP after intervention between the two groups were $p < 0.0001$ and $p = 0.002$, respectively. The mean heart rate (HR) after intervention in the intervention and control group was 91.46 ± 15.2 and 96.7 ± 10.4 , respectively. There was a significant difference in the mean HR after intervention between the two groups with ($p = 0.003$).

Table 3 portrays that there were a highly significant difference and improvement in fatigue level among children undergoing chemotherapy with an observed decrease in the fatigue scores among the intervention group compared to the control group.

As shown in **table 4** a highly statistically significant difference in fatigue level was observed between the mean pretest and post-test scores of the studied children undergoing chemotherapy in both intervention and control groups pre- and post-intervention with $p = < 0.05$ level.

Table 5 shows the mean pain after intervention in the intervention and control group was 35.14 ± 14.62 and 43.52 ± 16.45 . The independent t-test showed that the mean pain intensity was significantly lower in the intervention group than in the control group with ($p < 0.0001$).

As displayed in **figure 1** the majority of studied children undergoing chemotherapy in the intervention group and the control group (80% and 81%) respectively had a moderate level of pain pre-intervention. But post-intervention 67% of the studied children had a

mild level of pain the intervention compared to 19% in the control group.

Table 6 demonstrates that there was a statistically significant difference between the

mean pretest and post-test scores of studied children undergoing chemotherapy concerning pain levels in the intervention group with $p < 0.05$ level.

Table (1): Frequency and percentage distribution of the studied children undergoing chemotherapy regarding their demographic data (n=100)

Demographic data	Intervention group (n=50)		Control group (n=50)		X ²	P-value
	No.	%	No.	%		
Child's age Mean \pm Stander deviation	7.08 \pm 2.34		7.89 \pm 2.86		4	0.41 ^{NS}
Gender						
• Boys	31	62.0	30	60.0	3	0.18 ^{NS}
• Girls	19	38.0	20	40.0		
Child's educational level						
• 1-3	27	54.0	29	58.0	3	4.36 ^{NS}
• 4-6	23	46.0	21	42.0		
Residence:						
-Urban	36	72	35	70	2	1.26 ^{NS}
-Rural	14	28	15	30		
Duration of disease (in years)						
• <1	30	60.0	31	62.0	1.23	0.12 ^{NS}
• 1-5	13	26.0	12	24.0		
• 1-5	7	14.0	7	14.0		
• >5						

T-test, x² test, NS-non-significant

Table (2): Comparison between means score of the studied children undergoing chemotherapy in both intervention and study group regarding their physiological indicators (n=100)

Physiological indicators	Intervention group (n=50)	Control group (n=50)	t-test	p-value
Systolic blood pressure	89.35 \pm 16.67	57.87 \pm 12.8	17.23	< 0.0001*
Diastolic blood pressure	97.49 \pm 14.27	58.63 \pm 10.32	12.42	0.002*
Heart rate	91.46 \pm 15.2	96.7 \pm 10.4	10.32	0.003*

Table (3): Frequency and percentage distribution of posttest fatigue level among the studied children undergoing chemotherapy (n=100)

Fatigue level	Intervention group (n=50)		Control group (n=50)		t-test	P-value
	No	%	No	%		
No fatigue (0)	6	12	0	0.0	14.032	<0.001**
Very little (1-9)	10	20	0	0.0		
Mild (10-30)	18	36	0	0.0		
Moderate (3- 60)	16	32	21	42		
Severe (61-80)	0	0.0	16	32		
Worst (81-100)	0	0.0	13	26		

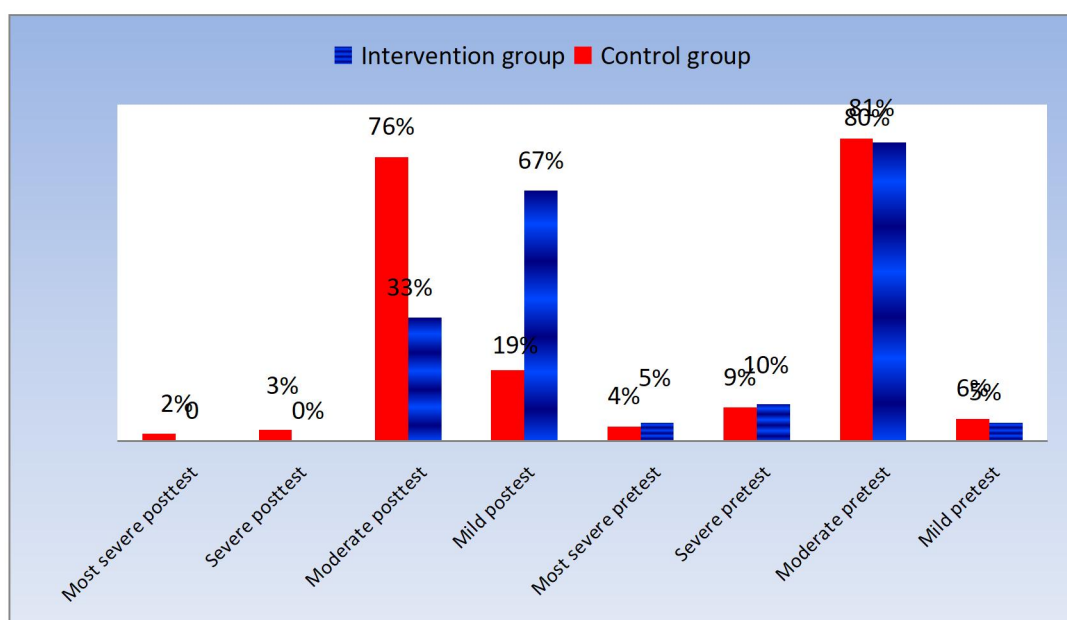
Table (4): Fatigue mean scores among studied children undergoing chemotherapy in both intervention and control groups pre- and post-intervention (n=100)

Group	Fatigue level				X ²	p-value
	Pretest		Posttest			
	Mean Score	SD	Mean Score	SD		
Intervention Group	3.56	1.07	2.67	1.08	58.2	<0.001**
Control Group	2.78	1.02	2.65	0.62	0.57	1.59 ^{NS}

NS=non-significant, *= significant at $p<0.05$ level

Table (5): Comparison between means score of the studied children undergoing chemotherapy in both intervention and study groups regarding their pain intensity (n=100)

Pain intensity	Intervention group (n=50)	Control group (n=50)	t-test	p-value
Systolic blood pressure	35.14 ± 14.62	43.52 ± 16.45	19.23	< 0.0001*

**Figure 1:** Percentage distribution of pain scores among studied children undergoing chemotherapy in both intervention and study groups pre and post-intervention (n=100)**Table (6):** Comparison between the studied children undergoing chemotherapy in both intervention and study groups pre and post-intervention as regards pain scores (n=100)

Group	Pain intensity				X ²	p-value
	Pretest		Posttest			
	Mean Score	SD	Mean Score	SD		
Intervention group	6.33	1.07	4.36	0.89	56.78	<0.001**
Control group	6.12	1.01	6.09	0.93	0.58	1.77 ^{NS}

NS=non-significant, *= significant at $p<0.05$ level

Discussion:

Chemotherapy side effects are no longer thought of as symptoms, but rather as subjective signs of distress that affect a child's quality of life. For children and adolescents receiving cancer treatment, exhaustion and pain continue beyond the course of treatment, unlike other cancer symptoms that could go away. Massage eases stress, discomfort, muscle tension, boosts circulation, and makes children more flexible (Abrams et al., 2019).

Concerning the demographic data of the studied children, it was observed that the mean age of the studied children was between 7.08 ± 2.34 and 7.89 ± 2.86 years old in the intervention group and control group respectively, more than half were males. These results were in the same line as those of Syan et al., (2019) who studied 90 children with leukemia at South Egypt Cancer Institute and found that more than two-fifths of children their mean age was 7.1 ± 3.5 years old, and more than half of the children were males

The results of the present study pointed out that in the intervention group, less than three-quarters of the studied children in both groups were living in urban areas. Results of the present study are inconsistent with Syan et al., (2017) who conducted a study entitled, Efficacy of distraction in pain relief during lumbar puncture in children with leukemia at South Egypt Cancer Institute " and found that more than two-thirds of children were from the rural area.

The findings of the current study indicated that no significant difference was detected between the two groups in their demographic data. From the researchers' point of view, this reflects that the baseline of pain and fatigue disturbances was similar in the two groups.

The results of the present study revealed that the means of systolic blood pressure, diastolic blood pressure, and heart rate in the intervention group were changed after intervention with a significant difference in the means scores after intervention between the two groups. From the researchers' point of view, this finding expresses the positive effects of

massage therapy on physiological Indicators and confirm the study hypothesis.

The results of this study are matched with Jazayeri et al., (2021) who studied " Comparison of the effect of foot reflexology and body massage on physiological indicators and bilirubin levels in neonates under phototherapy" and the results showed that massage was effective on systolic blood pressure.

Similarly, the current study finding is consistent with the results of the study conducted by Elsayed et al., (2019) entitled, "The Effect of Foot Reflexology on Physiological Indicators and Mechanical Ventilation Weaning Time among Open-Heart Surgery children "and showed that massage in both groups had a significant effect on systolic blood pressure, diastolic pressure, breathing, heart rate and mean temperature.

These results are also consistent with the results of Pinar and Afsar (2017) who revealed that massage could lead to a significant reduction in systolic and diastolic blood pressure, breathing, and heart rate, also could improve quality of sleeping in patients with cancer. In addition, blood pressure, heart rate, and pain scores in the intervention group were significantly better than in the control group. The current study results are consistent with the results of the study done by Moyle et al. (2018) about " Foot massage and physiological stress in people with dementia" and confirmed that foot reflexology could reduce the systolic and diastolic blood pressure in patients with dementia.

The results of the present study are consistent with those of a previous study on children with leukemia done by Ghazavi et al., (2019) about " Evaluation of the effects of foot reflexology massage on vital signs and chemotherapy-induced anxiety in children with leukemia " and the results showed that foot reflexology caused significant changes in the physiological indices of HR and blood pressure. The high impact of foot reflexology can be attributed anatomically to the presence of many nerves in the foot.

The current study finding reveal a highly significant difference and improvement in

fatigue level among children undergoing chemotherapy with an observed decrease in the fatigue scores among the intervention group compared to the control group. From the researcher's point of view, the findings of this study may be attributed to the physiological effects of massage, which can release endorphins and serotonin (which improve the mood) and may also enhance autonomic nervous system activity, resulting in an integrated effect at the hypothalamic level and relaxation response. Massage improved one's sense of well-being by reducing muscular stress and nervous system excitability. Also, young children enjoyed massage techniques and viewed it as a very fun, relaxing, and comfortable game.

These findings were consistent with those of **Salama et al. (2017)**, who examined the "Effect of Therapeutic Massage on Reducing Pain and Fatigue in Children with Cancer" among 60 patients with cancer between the ages of 1 and 18 years old in Egypt and found that therapeutic massage significantly reduced the severity of exhaustion in the children. According to research done by **Haun et al. (2019)** who studied "Children with cancer and blood diseases experience positive physical and psychological effects from massage therapy" and found that massage treatment could improve the quality of life for kids with cancer and blood illnesses by reducing physical and psychological pain.

Robison & Smith, (2016) studied "Therapeutic Massage during Chemotherapy and/or Biotherapy Infusions: Patient Perceptions of Pain, Fatigue, Nausea, Anxiety, and Satisfaction" and found that therapeutic massage for 20 minutes to patients concurrently receiving chemotherapy and/or biotherapy provided a statistically significant reduction in fatigue. **Karagozolu & Kahve, (2018)** studied the effects of back massage on chemotherapy-related fatigue and anxiety: Supportive care and therapeutic touch in nursing patients with cancer and tested the efficacy of back massage on the process of acute fatigue developing due to chemotherapy in patients with cancer and found that the level of fatigue in the intervention group decreased with statistically significantly difference in the next day after chemotherapy.

The findings of the present study revealed a highly statistically significant difference in fatigue level was observed between the mean pretest and post-test scores of the studied children undergoing chemotherapy pre- and post-intervention. This result, according to the researchers' point of view, demonstrates the positive effects of foot massage application, which fits the needs of the studied children undergoing chemotherapy and aids in the reduction and improvement of fatigue levels.

The results of the present study showed that the mean pain after the intervention was significantly lower in the intervention group than in the control group. From the researchers' point of view, this result is attributed to that during massage release of certain peptides is occurred, which have a sedating and analgesic effects resulting in the lowered activity of the sympathoadrenal system which activated during the stressful situations. Also, it reflected the noticeable effective impact of foot massage in reducing pain. These confirmed the significant modifications in the child's pain level that reflected the main goals of the massage intervention.

The results of the present study showed that post-intervention more than two-thirds of the studied children had a mild level of pain in the intervention group compared to less than one-fifth in the control group. The results of the current study are supported by **Khazaei et al. (2019)** who studied "The effect of foot reflexology massage on the stress and neuropathic pain caused by chemotherapy in patients with cancer" and showed that foot reflexology twice a day for 2 weeks could reduce the rate of neuropathic pain in patients with cancer, undergoing chemotherapy.

The results of the present study are agreed with the previous study in patients with appendectomy conducted by **Taheri et al., (2019)** and all of which showed that foot reflexology significantly reduced pain and indicated a positive effect of foot reflexology on pain relief.

The study finding revealed that there was a statistically significant difference between the mean pretest and post-test scores of studied children undergoing chemotherapy concerning pain levels in both experimental and control

groups. From the researchers' point of view, it reflects the success of foot massage application to reduce pain among studied children undergoing chemotherapy. This finding is supported by **Taheri, (2019)** who studied "Effect of Foot and Hand Reflexology on Pain Severity after Appendectomy" and reported a significant difference was observed between pre-and post-test in pain levels.

Conclusion:

Based on the findings and hypotheses of this study, it was concluded that foot massage was effective in improving physiological indicators and reducing fatigue levels and pain among children undergoing chemotherapy in the intervention group when compared to the control group after the intervention.

Recommendations:

Based on the current study results, the following recommendations are proposed:

- Foot reflexology can be used as a complementary treatment along with conventional therapies among children undergoing chemotherapy as a simple and applicable strategy to improve physiological indicators, reduce fatigue levels and pain.
- The method should be implemented as a low-cost intervention by nurses and other health groups to reduce pain, fatigue and improve physiological indicators.
- Further studies about the effect of different massage techniques on pain, physiological indicators, and fatigue among children undergoing chemotherapy to minimize the physical and psychological problems.
- Further studies should be done to investigate the effect of massage on controlling problems of cancer.

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