

## Effect of Reflexology Foot Massage on Leg Cramps for Patients on Hemodialysis.

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**Abstract:** Leg cramps are common problems in patients undergoing hemodialysis. It often results in the early termination of a hemodialysis session. This study aimed to evaluate the effectiveness of reflexology foot massage on leg cramps for patients on hemodialysis. It was conducted at the hemodialysis units of Al - Moassat Alexandria University Hospital and Dr. Montasser Zeid Nephrology Center, from August 2014 to November 2015. The sample included 66 adult patients undergoing hemodialysis, divided equally into study and control groups, 33 patients each. Three tools were used to collect necessary data, hemodialysis patient's assessment, leg cramps intensity scale and leg cramps assessment. The findings of the study revealed that there was no statistical significant difference between the study and control groups in relation to leg cramps intensity, duration, alleviating factors, and frequency before interventions. While, patients on hemodialysis experienced significantly decreased leg cramps intensity, duration and frequency throughout the nine massage sessions among the studied patients over the control groups. This study concluded that hemodialysis patients who receive reflexology foot massage had significant decrease in leg cramps intensity levels, frequency and duration. In addition to the improvement of physical activities, emotional wellbeing, sleeping pattern and social activities. This study recommended that reflexology foot massage should be used as evidence base for nursing practice with patients on hemodialysis.

**Keywords:** Hemodialysis, leg cramp, Reflexology foot massage

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### I. Introduction

Leg cramps are a common complaint encountered by 33 to 86% patients undergoing hemodialysis. Leg cramps are defined as the sudden onset, painful and prolonged involuntary muscle contraction that may be visible or palpable<sup>(1,2)</sup>. Despite the "benign" nature of cramps, many patients find the symptom very uncomfortable<sup>(3)</sup>. The exact etiology of cramps in dialysis patients is unknown and effective anti- cramp medicine is not available.

Cramps tend to occur most frequently near the end of hemodialysis sessions; due to changes in plasma osmolality and /or extra cellular fluid volume have been implicated. Leg cramps are treated by non-pharmacological interventions before any medications are commenced<sup>(2,4)</sup>. The psychological impact of cramps is often overlooked, yet cramps have a significant impact on patient mood and quality of life. Repeated episodes of muscle cramps contribute to chronic pain, lack of sleep, decrease patient's physical and social activities – which, in extreme cases, has been implicated in patient decisions to ultimately withdraw from dialysis treatment<sup>(5,6)</sup>.

Recurrent muscle cramps during dialysis frequently lead to noncompliance with the prescribed hemodialysis treatment. The experience of cramps often result in the early termination of a hemodialysis session and are therefore a significant cause of underdialysis, chronic fluid overload, hypertension and cardiovascular disease<sup>(7)</sup>. Currently no treatments for leg cramps are proven to be safe and effective. Massage therapy may relieve cramp and it has been recommended to prevent cramps<sup>(8)</sup>.

The use of complementary and alternative medicines (CAM) has increased in conventional health care settings. New approaches considered the nurse as a healing agent and has independent role in patient's care. The term holistic nursing arose from this approach. To enhance complementary medicine, nurses can develop their professional practices. Complementary and alternative medicine is the most commonly used term to cover health care practices and products used primarily outside the formal health care system<sup>(9-11)</sup>. Usually, the fear of medication side effects and desire for symptom relief are possible reasons for the increasing use of CAM by patients. So, nurses incorporated CAM into their practice<sup>(9,10)</sup>.

Reflexology is the oldest treatment in the world, based on scientific massage technique and has been developed since ancient Chinese and Egyptian times. The most primary scientific images of reflexology

massage were discovered in Ankhmahor tomb in Egypt in 2500 B.C<sup>(12)</sup>. Reflexologists, as Dr. Fitzgerald and Eunice Ingham, believed that feet are a small map of the whole body on which all organs and body parts are reflected. In that intervention, the therapist using his fingers – specially the thumbs – with pressurizing on certain reflex points or centers on the feet that have been claimed to correspond to the internal organs, glands and body parts lead to restore health and had made a balance throughout the whole body<sup>(13-15)</sup>.

No doubt that, reflexology massage has been widely used in nursing specialties which include midwifery, orthopedics, neuroscience and palliative care. However, many CAM modalities lack scientific evidence to support their efficacy and safety. While, anecdotal evidence has shown that reflexology massage is beneficial in many conditions such as pre- and postnatal discomfort, pain, migraine and chronic obstructive pulmonary disease<sup>(6,8,13)</sup>.

As reflexology massage has become popular in nursing practice, so this study aims to evaluate the effectiveness of reflexology foot massage on leg cramps for hemodialysis patients. Hopefully this intervention will be a contribution towards resolving some of the adverse physical and psychological symptoms associated with the illness and its treatment, for all patients undergoing hemodialysis

**Aim of the study:**

The aim of the study is to evaluate the effectiveness of reflexology foot massage on leg cramps for patients on hemodialysis.

**Research hypothesis:**

Research hypothesis is:

Hemodialysis patients who receive reflexology foot massage experience less leg cramps than those who do not receive such intervention.

**Materials and method:**

**Materials:**

**Design:**

A quasi experimental design was used in the present study.

**Setting:**

The study was conducted at the hemodialysis units of Al - Moassat Alexandria University Hospital and Dr. Montasser Zeid Nephrology Center

**Subjects:**

The study subjects comprised a convenience sample of 66 adult patients of both sexes with chronic renal failure undergoing hemodialysis, in the above mentioned settings. Statistical Program Epi-Info. was used to estimate the sample size using the following parameters:

- 1) Population size = 200 (from the dialysis unit admission records of both settings 120 patients from the hemodialysis unit of Al - Moassat University Hospital and 80 patients from Dr. Montasser Zeid nephrology center)
  - 2) Proportional = 50%
  - 3) Error = 10%
  - 4) Confidence coefficient = 95%
  - 5) Sample size = 66 patients in total
- The total number of subjects was randomly divided into two equal groups: 33 patients in each of the study and the control group.

**The subject inclusion criteria were: Adult patients:**

1. Age from 21 to 60 years
2. Willing to participate in the study and cooperate
3. Able to communicate verbally
4. Being dialyzed 3 times weekly
5. Free from any of the following:
  - Peripheral neuropathy.
  - Injury on the foot including severe bruises, ulceration, open wound or recent burn.
  - Peripheral vascular diseases in the lower limbs.
  - Skin diseases including acute psoriasis or eczema.
  - Recent fracture or surgery in the leg.

**Tools:**

Three tools were used in this study.

**Tool I: Hemodialysis Patients Assessment Tool:**

It was constructed by the researcher after review of relevant literature <sup>(16,17)</sup> and it included sociodemographic characteristics include; age, sex, educational level and clinical characteristics include: duration of hemodialysis in years, and inter-dialytic weight gain.

**Tool II: Leg Cramps Intensity Scale:**

Visual Analog Scale (VAS) for leg cramps was used: for assessing leg cramps intensity. This tool was developed by Cline et al. (1992)<sup>(18)</sup>. It is a horizontal line, 10cm in length, anchored by word descriptors at each end; left end no leg cramps at all and right end cramps as bad as they can possibly be. The scoring values are allotted as (0) indicates no leg cramps, (1-3cm) illustrates mild leg cramps, (4-6cm) indicates moderate leg cramps (7-9cm) indicates severe leg cramps and (10cm) very severe leg cramps.

**Tool III: Leg Cramps Assessment:**

It was developed by the researcher after review of relevant literature <sup>(19,20-22)</sup> and it consisted of two parts:

**Part (I):** it included the following items related to leg cramps:

1. Site (right leg, left leg or both legs)
2. Onset: gradually or suddenly
3. Alleviating factors: dangling, walking, rubbing, reflexology foot massage or others.
4. Duration in minutes
5. Frequency

Patient's responses, on each item of this part of the tool, were calculated as numbers and percentages.

**Part (II):** this consisted of items related to leg cramps effect on:

**1. Sleep pattern:** it included 9 questions related to time of leg cramps occurrence during day or night sleep, sleep description, sleep quality, wake up during sleep because of leg cramps, number of wake up, trouble returning to sleep, time needed to return to sleep, decrease sleeping hours because of leg cramps and interference of sleep problem with daily functioning.

Patient's responses, on each item related to leg cramps effect on sleep pattern were checked and the total response was calculated as number and percentage.

2. **Physical activities** included 5 items related to limitation on sports or exercise, stair-climbing, walking, sitting & standing due to leg cramps. It was assessed on a 4 point rating scale ranging from (0) = Not at all, (1) = Somewhat, (2) = Much and (3) = Very much.
3. **Emotional well- being** was composed of 6 items related to leg cramps effect on interest in doing activity, feeling depressed, angry, frustration, low mood & being fearful. It was assessed on a 4 point rating scale ranging from (0) = Not at all, (1) = Somewhat, (2) = Much and (3) = Very much.
4. **Social activities** included 5 items related to leg cramps effect on getting out from home, participating in social activities, participating in household chores, ability to accomplish hard work & meeting people's demands. It is assessed on a 4 point rating scale ranging from (0) = Not at all, (1) = Somewhat, (2) = Much and (3) = Very much.

## **II. Method**

- An official letter from Alexandria faculty of Nursing was submitted to the general director of (Al - Moassat Hospital and Dr. Montasser Zeid Nephrology Center) and to the head of the department of medical nephrology unit of Al- Moassat Hospital. Permission to carry out the study was obtained after complete explanation of the study aim.
- Study tools were developed; Tool I and Tool III were developed by the researcher and were translated into Arabic. Content validity for both English and Arabic versions were tested by 5 experts in the field of medical surgical nursing and 4 experts in nephrology medicine. The required corrections and modifications were carried out accordingly.  
Reliability of the tools was done using Cronbach's Alpha. Reliability of tools items related to effect of leg cramps on physical activities was 0.667, reliability of tools items related to effect of leg cramps on emotional well- being was 0.983 and reliability of tools items related to effect of leg cramps on social activities was 0.988.
- A pilot study was carried out on 7 patients from the study settings to ensure the clarity, applicability, relevance, and feasibility of the tools, to identify the difficulties that may be faced during massage application, and to estimate the time needed for data collection. Subjects who participated in the pilot study were not included in the main study sample.

- Subject selection, patient who fulfilled the sample selection criteria was contacted and the researcher introduced herself to every patient included in the study, the aim of the study and the process of reflexology foot massage and its expected outcome benefits were explained in details. After that informed patient's written consent for participation in the study was obtained. Every patient was informed that the researcher would assure their anonymity, privacy and confidentiality throughout the caring process. Voluntary participation and right to withdraw from the study was emphasized to every subject.
- Data collection was carried out in two phases: data related to the control group and data related to the study group. The total period of data collection for both groups was 13 months from August 2014 to August 2015. The researcher observed every patient in both groups during the whole period of hemodialysis session and when cramp occurs during hemodialysis. Every patient was interviewed during the first hemodialysis session to obtain sociodemographic and clinical data by using tool I. In the control group leg cramps assessment was taken as the following: first assessment when leg cramps started the researcher assessed intensity using Tool II: (leg cramps intensity scale). Second leg cramps assessment was carried out after 5 minutes from the start of leg cramps using the same tool. Leg cramps of the control group were also assessed 4 times for one month, once per week using part I and II of Tool III (Leg Cramps Assessment)
- In the study group leg cramps assessment was taken as the following: first assessment when leg cramps started the researcher assessed its intensity using Tool II (leg cramps intensity scale). Second leg cramps assessment was carried out immediately after application of reflexology foot massage sub session; it was done by applying pressure to solar plexus point, leg point and sciatic nerve point in the foot of the affected leg for 5 minutes, using the same tool. Every patient in the study group received complete reflexology foot massage session for 40 min (20 min for each foot) to all reflex points in the foot guided by reflexology foot massage map. It was done three times in the week, (every other day), for three weeks for a total 9 sessions per patient immediately after nine subsequent hemodialysis sessions. Leg cramps were assessed 4 times for one month, once per week using part I and II of Tool III (Leg Cramps Assessment).

### III. Statistical Analysis

After data collection, data were fed to the computer using Statistical Package for Social Sciences (SPSS version 18.0). The 0.05 level was used as the cut off value for statistical significance and the following statistical measures were used. Descriptive Statistics: frequency distribution, means and standard deviations. Analytical statistics which include: Kolmogorov – Smirnov test , t-test and Mann Whitney test ,Chi-Square test, Monte Carlo test and Fisher's Exact test .

### IV. Results

**Table (1):** Shows frequency distribution and significance of differences of socio-demographic and clinical characteristics among the study and control groups of patients on hemodialysis. This table revealed that (36.4%) in the study group were between (20 - < 30 years), while for the control group less than half (45.5%) were between (50 -< 60 years). (60.6%) was males in both groups. Nearly one third (36.4%) and (33.3%) respectively of the study and control groups hold a diploma degree. Regarding duration of hemodialysis in years, it was between (1-< 3 years) in one third (33.4%) of the study group and between (3-< 6 years) in slightly more than one third (36.4%) of the control group. In relation to inter- dialytic weight gain the highest percentage (66.7%, 48.5%) respectively in the study and the control groups, gained (1.5-<2.5Kg). There was no statistical significant difference between both study and control groups regarding any of the above mentioned characteristics.

**Table (2):** Represents frequency distribution of leg cramps intensity among the study and control groups and significance of differences before and after reflexology foot massage sub sessions of patients on hemodialysis. The table revealed that there was no statistical significant difference between both study and control groups in relation to leg cramps intensity before the nine reflexology foot massage sub session, whereas the majority in both groups experienced severe leg cramps. While, patients on hemodialysis experienced significantly decreased leg cramps intensity among the studied patients after applications of reflexology foot massage throughout the nine massage sessions.

**Table (3):** shows frequency distribution of weekly leg cramps assessment findings among the study and control groups and significance of differences before and after reflexology foot massage sessions of patients on hemodialysis. There was no statistical significant difference in the first assessment and in the second assessment between both groups regarding leg cramps site and onset. There was no statistical significant difference within the study group as well as within the control group in relation to leg cramps *site and onset* in the first and second assessment. In relation to leg cramps *alleviating factors* in the first assessment, from those who experienced leg cramps, more than three quarters (78.6%) and the majority (83.3%) respectively of the study and control groups alleviated leg cramps by rubbing and there was no statistical significant difference. In the second assessment the majority (80.0%) of the study group decreasing it by rubbing, while the majority (83.3%) of the control group

alleviated it by rubbing and dorsiflexion and the difference was statistically significant ( $p=0.035^*$ ). There was statistical significant difference ( $p= 0.041^*$ ) between the first and second assessment in relation to leg cramps alleviating factors in the study group. There was no statistical significant difference between the first and second assessment in relation to leg cramps alleviating factors in the control group.

As regards **duration** of leg cramps the first assessment before applying any massage, from those who had leg cramps, the highest percentages (92.9%) and (66.7%) respectively of the study and control groups were between (4-<6 minutes). The lowest percentage (7.1%) of the study group was between (6-<8 minutes), while the lowest percentage (8.3%) of the control group was between (8-<10 minutes) and the difference was not statistically significant.

The table exhibited that duration of leg cramps during the second assessment after applying three massage sessions, from those who had leg cramps, the highest percentage (70.0%) of the study group was between (2-<4 minutes). Two thirds (66.7%) of the control group compared to less than one third (30.0%) of the study group were between (4-<6 minutes). Seeing that, one third (33.3%) of the control group was between (8-<10 minutes). The difference was statistically significant ( $p = 0.003^*$ ) in the study group over the control. There was a statistical significant difference ( $p= 0.043^*$ ) between the first and second assessment in relation to leg cramps duration in the study group. There was no statistical significant difference between the first assessment and the second assessment in relation to leg cramps duration in the control group.

The same table also clarified that leg cramps **frequency** in the first assessment, from those who had leg cramps, less than two thirds (64.3%) of the study group compared with more than two fifths (41.7%) of the control group had leg cramps three times per week and there was no statistical significant difference. In the second assessment, the majority (80.0%) of the study group compared to the lowest percentage (16.7 %) of the control group experienced leg cramps once per week and there was statistical significant difference ( $p= 0.021^*$ ) in the study group over the control. There was statistical significant difference ( $p= 0.006^*$ ) between the first and second assessment in relation to leg cramps frequency in the study group. There was no statistical significant difference between the first and second assessment in relation to leg cramps frequency in the control group. Leg cramps didn't occur during the third assessment or during the fourth assessment in the study group.

**Table (4):** Shows effect of leg cramps on sleep pattern among the study and control groups and significance of differences before and after reflexology foot massage sessions of patients on hemodialysis. Concerning the first assessment, the majority (85.7%) of the study group and all (100.0%) of the control group described their sleep as "Not deep sleep". There was no statistical significant difference between both groups. In the second assessment the majority (90.0%) of the study group described their sleep as "deep sleep" compared to all (100.0%) of the control group described their sleep as "Not deep sleep". The difference was statistically significant ( $p= 0.001^*$ ). There was statistical significant difference ( $p= 0.0005^*$ ) in the study group between one the first and second assessment.

It was noticed that there was no statistical significant difference between both study and control groups regarding **effect of leg cramps on sleep quality** in the first assessment. As, from those who experienced leg cramps, more than three quarters (78.6%) of the study group and the majority (91.7%) of the control group "had adequate sleep". In the second assessment, all (100.0%) of the study group "had good sleep" while, two thirds (66.7%) of the control group "had adequate sleep" and the difference was statistically significant ( $p= 0.002^*$ ). There was statistical significant difference ( $p= 0.0002^*$ ) in the study group between the first assessment and the second assessment. While, there was no statistical significant difference in the control group between the first and second assessment, between first and third assessment or between first and fourth assessment.

The table clarified that **the effect of leg cramps on wake up from sleep** in the first and second assessment, all (100.0%) of the study and control groups who experienced leg cramps wake up from sleep due to leg cramps.

Data from the same table revealed that **effect of leg cramps on number of waking up during sleep**, in the first assessment, all (100.0%) of the study and the majority (91.7%) of the control group waked up once. There was no statistical significant difference between both groups. Moreover, in the second assessment, all (100.0%) of the study and the majority (83.3%) of the control group waked up once and there was no statistical significant difference.

As regards **effect of leg cramps on sleeping hours**, in the first assessment, sleeping hours were affected by leg cramps in less than two thirds (64.3 %) of the study group and the majority (91.7%) of the control group and the difference was not statistically significant. Whereas, in the second assessment sleeping hours were not affected by leg cramps in the majority (90.0%) of the study group while, sleeping hours were affected by leg cramps in the majority (83.3%) of the control group and the difference was statistically significant ( $p= 0.008^*$ ). There was statistical significant difference ( $p= 0.013^*$ ) in the study group between the first assessment and the second assessment. While, there was no statistical significant difference in the control group between the first and second assessment, between first and third assessment or between first and fourth assessment.

Eventually, **the extent of leg cramps effect on sleep**, in the first assessment, less than two thirds (64.3 %) of the study group compared to half (50.0%) of the control were affected "Somewhat" by leg cramps. Moreover, the lowest percentages (7.1%,8.3%) respectively of the study and control groups sleep was not affected by leg cramps at all" and the difference was not statistically significant. While, in the second assessment, less than three quarters (70.0%) of the study group affected "a little", whereas the majority (83.3%) of the control group affected "Somewhat" by leg cramps and the difference was statistically significant ( $p=0.014^*$ ). There was statistical significant difference ( $p=0.029^*$ ) in the study group between the first assessment and the second assessment. While, there was no statistical significant difference in the control group between the first and second assessment, between first and third assessment or between first and fourth assessment.

**Table (5):** Illustrates effect of leg cramps on physical activity among the study and control groups and significance of differences before and after reflexology foot massage sessions of patients on hemodialysis. It was noticed that there was no statistical significant difference among the study and control groups in the first assessment in all the subscales items related to the effect of leg cramps on sports, stair climbing, walking, sitting and standing. In the second assessment, there was no statistical significant difference among the study and control groups related to effect of leg cramps on sports and stair climbing. Whereas, there was statistical significant difference in the study group over the control related to effect of leg cramps on walking, sitting and standing ( $p=0.036^*$ ,  $0.004^*$  and  $0.036^*$ ) respectively.

Regarding significant for each group, there was no statistical significant difference related to effect of leg cramps on sports and stair climbing. Whereas, there was statistical significant difference ( $p=0.019^*$ ,  $0.034^*$  and  $0.019^*$ ) respectively related to effect of leg cramps on walking, sitting and standing between the first and second assessment. Whilst, there was no statistical significant difference in the control group between the first and second assessment, between first and third assessment or between first and fourth assessment.

**Table (6):** Shows effect of leg cramps on emotional well-being among the study and control groups and significance of differences before and after reflexology foot massage sessions of patients on hemodialysis. It was noticed that there was no statistical significant difference among the study and control groups in the first assessment in all the subscales items related to little interest in work, feeling depresses, feeling angry, feeling frustration and low mood. There was statistical significant difference ( $p=0.0001^*$ ) in all emotional well-being subscale items between both groups in the second assessment. As for, significant in the study group between the first and second assessment the difference was statistically significant in all subscale items. There was a statistical significant difference ( $p=0.0002^*$ ) in the study group between the first assessment and the second assessment. Whereas, there was no statistical significant difference in the control group between the first and second assessment, between first and third assessment or between first and fourth assessment.

**Table (7):** Represents effect of leg cramps on social activities among the study and control groups and significance of differences before and after reflexology foot massage sessions of patients on hemodialysis. It was observed that there was no statistical significant difference among the study and control groups in the first assessment in all the subscales items including getting out from home, participation in social activities, participation in household chores, accomplishment of hard work and meeting demands. While, there was statistical significant difference ( $p=0.008^*$ ) in all social subscale items in the study group over the control in the second assessment. In relation to significant in the study group, the difference was statistically significant between the first and second assessment in all the subscale items. There was a statistical significant difference ( $p=0.0002^*$ ) in the study group between the first assessment and the second assessment. Whereas, there was no statistical significant difference in the control group between the first and second assessment, between first and third assessment or between first and fourth assessment.

## V. Discussion

The results of the present study revealed that there were no statistical significant differences in sociodemographic and clinical data between the study and control groups which included age, sex, level of education, duration of hemodialysis and/or inter-dialytic weight gain. These findings roll out the extraneous factors that might confuse the effect of reflexology foot massage.

As for leg cramps intensity among patients on hemodialysis, the findings of the study revealed that there was no statistical significant difference between the study and the control groups in relation to leg cramps intensity among patients on hemodialysis. Nearly all patients who experienced leg cramps in both groups had severe leg cramps before applications of reflexology foot massage sessions. The result of the present study is congruent with Holley et al.(2013) and Mehta et al.(2010) who reported that leg cramps among patients on hemodialysis were severe<sup>(23, 24)</sup>. In contrary to the results of the present study, Mohamed et al. (2007) whose study results revealed that the majority (88.33%) of their study sample experienced moderate leg cramps intensity<sup>(25)</sup>.

The current study findings revealed that patients on haemodialysis experienced significantly decreased leg cramps intensity among the studied patients after applications of reflexology foot massage throughout the

nine massage sessions. These findings might be attributed to proprioceptors reflexology theory according to this theory there are approximately 7,200 nerve endings in each foot. They send information up to the brain, and bring back the appropriate response to decrease muscle congestion, promote relaxation and increase brain endorphin. In addition, the improvement in HD cramps after reflexology foot massage explained by zone reflexology theory according to this theory energy is constantly flowing in the body through ten invisible channels from head to feet in line with all toes ending in the tips. On these ten energy pathways exist some reflex points when pressed with thumbs or fingers create a balance of energy where there was previously an imbalance. So, pressure on leg reflex points when cramp occurs will relieve it. Karag (2006) stated that treats of various areas of the body through corresponding reflex points on the foot, stimulating energy to promote healing. It is thought that the massage relieves the mind and muscles and increase the pain threshold<sup>(26)</sup>.

Findings of the present study are consistent with Ozdemir et al. (2013) stated that the severity of cramps in patients on haemodialysis decreased in patients receiving reflexology foot massage<sup>(27)</sup>. A study conducted by Bozan and Anadolu (2013) discovered that pain and cramping in the foot were decreased when haemodialysis patients underwent a course of 30 minutes reflexology sessions after treatment<sup>(28)</sup>. Another supporting study by Anne et al. (2015) who evaluated the effectiveness of 20 minutes feet massage during each hemodialysis treatment for 2 weeks resulting in up to 6 massage sessions<sup>(29)</sup>. These results revealed that foot massage was an effective nursing intervention in decreasing leg cramps intensity.

Leg cramps occurring during hemodialysis was explained by Diroll (2015) who stated that low blood volume, poor circulation and tissue hypoxia during hemodialysis result in leg cramps, so improving circulation by foot massage, increasing tissue oxygenation and decreasing leg cramps frequency and intensity<sup>(30)</sup>. Jang and Kim (2009) stated that self-foot reflexology is an effective nursing intervention in improving blood circulation and decreasing cramps severity<sup>(31)</sup>. Jones et al. (2012) conducted a systematic review analysis and concluded that reflexology massage has positive effect and significant post-test on selected cardiovascular parameters or any hemodynamic parameters potentially involved in the regulation of circulating blood flow volume including heart rate and systolic and diastolic arterial blood pressure<sup>(32)</sup>. This study confirmed the effect of reflexology massage on improving circulation and decreasing cramps. While, on the contrary a study done by Jones et al. (2013) showed that reflexology massage had no effect on haemodynamic status or blood circulation among patients with congestive heart failure (CHF)<sup>(33)</sup>. This contradiction might be related to the difference between Jones's study technique, which included reflexology massage only to the heart reflex point area in the left foot and this is different from the present study technique in which reflexology massage had been applied to all reflex points in both feet in systematic approach guided by reflexology foot massage map.

In relation to weekly assessment findings of leg cramps that occur between the hemodialysis sessions among the study and control groups, results of the present study showed that, there was no statistical significant difference between both study and control groups in the first assessment before applying any reflexology foot massage sessions in relation to leg cramps site, onset, alleviating factors, duration and frequency. Results of the present study showed that, there was no statistical significant difference between both study and control groups regarding leg cramps site and onset in the second assessment after applying three reflexology foot massage sessions. Meanwhile, there was statistical significant improvement in the study group over the control in relation to leg cramps alleviating factors including rubbing or dorsiflexion as well as decreasing duration and frequency. This result confirms the reflexology therapeutic effects in increasing blood circulation, since the blood stream is responsible for supplying the muscles with nutrients and oxygen. Hence increased circulation can assist in preventing cramps, spasms, aches and pains associated with extended exercise<sup>(30)</sup>.

In line with this result, Anne et al. (2015) conducted a study to evaluate the effectiveness of 20 minutes feet massage during each hemodialysis treatment for 2 weeks resulting in up to 6 massage sessions<sup>(29)</sup>. Patients reported that incidences of cramping at home decreased in the intervention group compared to the control group. The results of the present study are congruent with Ozdemir et al. (2013) who investigated the effect of reflexology applied on hemodialysis patients with cramps<sup>(27)</sup>. The research results revealed that the severity, duration and frequency of cramps decreased in patients receiving reflexology massage. Also, Khojandi (2005) pointed out that there was significant difference in mean scores of restless leg syndrome severity including decreased leg cramps severity, duration and frequency in reflexology massage group compared to control group among patients undergoing hemodialysis<sup>(34)</sup>.

In relation to the effect of leg cramps on sleep pattern, results of the present study showed that, there was no statistical significant difference between both study and control groups regarding effect of leg cramps on sleep pattern in the first assessment before applying reflexology foot massage. Also, there was no statistical significant difference between both study and control groups in relation to leg cramps occurring during day or night sleep and number of waking up from sleep in the second assessment after applying three massage sessions.

This result is in agreement with Ondo (2015) who reported that leg cramps symptoms are generally worse in the evening & at night<sup>(35)</sup>. Moreover, kanaan and Sawaya (2001) stated that leg cramps commonly happen at night where the plantar flexed foot places the calf, ventral foot muscles in the most shortened and

vulnerable position<sup>(36)</sup>. This result is in agreement with Culebras (2003) who reported that, when leg cramps appear before going to sleep, it may interfere with falling asleep & leads to a sleep deficit<sup>(37)</sup>. Another study done by Walgreens (2008) showed that, leg cramps that awaken people during sleep are very common & they are not part of periodic limb movement disorder, they can be very painful may cause jumping out of the bed in the middle of the night<sup>(38)</sup>. Khajehdehi (2001) stated that most commonly patients on hemodialysis complain of waking up in the night with severe leg pain due to cramps, which interferes with functioning in normal life<sup>(19)</sup>.

In the second assessment after applying three massage sessions there was statistical significant improvement in the study group over the control as regards to sleeping pattern including sleep depth, sleep quality, waking up from sleep due to leg cramps, number of waking up, trouble in returning to sleep and interference of sleep problem with daily functions. Moreover, there was statistical significant improvement in the study group between the first and second assessment. Whereas, there was no statistical significant improvement in the control group between the first and second assessment, between the first and third assessment and between the first and fourth assessment.

This may be due to application of reflexology massage, according to reflexologist local finger pressure can influence the functions of organs encouraging homeostasis, promoting deep relaxation and the healing response, which may help to improve sleep and ease tension<sup>(39)</sup>. Moreover improvement in sleeping pattern was a reflection to decreasing nocturnal leg cramps frequency, duration and intensity secondary to application of reflexology massage.

In endorsement with this results Song and kim (2006) reported that foot reflexology massage improved quality & depth of sleep and reduced depression due to increasing the level of serotonin<sup>(40)</sup>. Moreover, Khojandi (2005) found improvement in sleep pattern in reflexology massage group compared to control group<sup>(34)</sup>. Another supporting study done by Xavier (2007) reported that reflexology massage improved sleep quality<sup>(41)</sup>. Siev-Ner et al.(2003) pointed out that reflexology foot massage usually takes 3 to 4 sessions to see noticeable improvement<sup>(42)</sup>. They applied reflexology massage 3 times for 2 weeks and by the end of the first week, there was significant improvement in sleep quality. Moreover, Lee et al (2011) conducted a systematic review to evaluate the effects of foot reflexology on sleep including 18 studies; this systematic review indicated that foot reflexology was a useful nursing intervention to induce deep sleep<sup>(43)</sup>.

Regarding effect of leg cramps on physical activities, results of the present study showed that, there was no statistical significant difference between both study and control groups in the first assessment before applying any reflexology massage. This result is supported by Khajehdehi (2001) who stated that most commonly patients on hemodialysis complain of waking up in the night with severe leg pain due to cramps, which interferes with functioning in normal life including physical activities<sup>(19)</sup>. On the other hand, this result is in agreement with Chokroverty (2015) who said that over exertion, standing on concrete for long period or prolonged sitting especially with the legs contorted may contribute to leg cramps<sup>(44)</sup>. Also Claman (2006) emphasized that, when playing sports, muscle fatigue as well as vigorous use of the muscles can cause cramping, these cramps can occur either during & after the physical activities<sup>(45)</sup>.

While, there was a statistical significant difference between both study and control groups regarding leg cramps effect on physical activities in the second assessment after applying three massage sessions. Also, there was statistical significant improvement in the study group between the first and second assessment. While, there was no statistical significant improvement in the control group between the first and second assessment, between the first and third assessment and between the first and fourth assessment.

This result may be attributed to the effect of reflexology on decreasing leg cramps intensity, frequency and duration may increase patient's ability to perform physical activities, as some patients from the current study participants reported that reflexology massage relieve leg cramps as soon as muscle pain after cramp so, ability to walk, stand and climb stairs increased. This finding is in harmony with Quattrin et al. (2006), Ross et al.(2005), Wright et al. (2002), Hodgson (2000) and Stephenson et al. (2000) studies which revealed that reflexology massage improve physical activities<sup>(46,47,48,49,50)</sup>.

Siev-Ner et al. (2003) stated that when reflexology massage was applied 3 times for 2 weeks, it was noticed that by the end of the first week, that there was significant improvement in doing anything during the day, doing things around the house and rearranged the entire house<sup>(42)</sup>. Moreover, Weerapong et al. (2005) reported that reflexology massage stimulate the parasympathetic nervous system and evoke the relaxation response, enhance venous return, mobilize deep muscle tissue, the skin and subcutaneous tissue, increase local circulation, also it has reflex stimulation that decrease neuromuscular excitability, pain, muscle tension or spasm and break up any adhesions from old injuries<sup>(38)</sup>.

As for the effect of leg cramps on emotional well-being, the findings of the present study revealed that there was no statistical significant difference between both study and control groups regarding effect of leg cramps on emotional well-being in the first assessment before applying any reflexology massage. Moreover, there was statistical significant improvement in the study group between the first and second assessment.



Whereas, there was no statistical significant improvement in the control group between the first and second assessment, between the first and third assessment and between the first and fourth assessment.

This finding is supported by Khajehdehi (2001) who stated that most commonly patients on hemodialysis complain of waking up in the night with severe leg pain due to cramps that affect patient's psychological status and interferes with functioning in normal life<sup>(19)</sup>. Whereas, there was a statistical significant improvement between both study and control groups regarding leg cramps effect on emotional well-being in the second assessment after applying three massage sessions. This finding is consistent with the study done by Gambles et al. (2002) reported that the human touch accompanied by reflexology offers care and attention for patients, and increase psychological comforting<sup>(51)</sup>. This result is in line with Lee (2006) who expressed that there was a statistically significant improvement in depression and perceived stress<sup>(52)</sup>.

In relation to effect of leg cramps on social activities, results of the present study showed that, there was statistical significant improvement among the study than control group regarding leg cramps effect on social activities in the second assessment after applying three massage sessions. This finding is in harmony with Ross et al(2005) who found that reflexology massage improve physical activities and psychological status which in turn result in improving social activities<sup>(47)</sup>. Also, Lee in (2006) suggested that self –foot reflexology massage could be utilized as an effective nursing intervention to reduce depression and stress response and in turn improve psychological status and socialization<sup>(52)</sup>.

The results of the present study indicated that the number of patients who experienced leg cramps was lower in the second assessment after applying three massage sessions than the number before massage application in the study group. In addition, there was complete resolution of leg cramps occurring in between dialysis sessions during weekly leg cramps assessment in the third assessment after applying six massage sessions and in the fourth assessment after applying nine massage sessions. It was noticed that after application of the first reflexology massage session patients in the study group reported much deeper sleep and decrease in the leg cramps severity. Moreover, the study subjects reported that leg cramps occurred on their hemodialysis days but after massage muscles become relaxed and prevent leg cramps occurrence in between dialysis sessions.

This may be explained by cumulative and preventive effects of reflexology massage. Reflexologists postulate that malfunctioning of body systems or muscles are due to deposits of uric acid or calcium crystalline that accumulate on nerve ending and obstruct lymph flow on the feet<sup>(53,54)</sup>. Massaging these nerve endings in the feet would break down the crystalline deposits so that they can be reabsorbed and eliminated. Another theory stated that reflex points are nerve receptors, the stimulation of which block impulses to muscle spindle cells and to Golgi tendon; reduces muscular tension, induce relaxation, prevent muscle cramps and reduce psychological tension<sup>(53,55)</sup>.

It is clear from the previous discussion that patients who underwent hemodialysis and were managed with reflexology foot massage had a decrease in leg cramps intensity, frequency, and an improvement in physical activities, psychological status and social activities. In addition, reflexology foot massage improved their sleeping pattern. It is time that health care organizations strive towards evidence-based reflexology massage, educate their staff on reflexology technique, determine the barriers to its application in nursing practice and plan for strategies to overcome those barriers in order to ensure the best patient's management outcome. Physicians, nurses and administrators must collaborate to ensure that evidence-based practices are implemented and enforced in the clinical settings.

## **VI. Conclusion**

### **It can be concluded from the present study results that:**

Patients on hemodialysis who underwent a course of 40 minutes reflexology massage after the hemodialysis session on all reflex points on both feet, 3 times per week, for 3 consecutive weeks with a total of 9 massage sessions; had significant decrease of leg cramp intensity levels, frequency and duration, improvement of physical activities, emotional wellbeing and sleeping patterns and social activities.

### **Recommendations:**

#### **The findings of this study lead to the following recommendations:**

Reflexology foot massage should be **used as evidence base for nursing practice** with patients on hemodialysis through the following:

1. Incorporate the technique in clinical nursing curricula, so that students will be trained to use it as an integral part of the care of patients on hemodialysis.
2. Teach the technique to faculty teaching staff and their assistants in order to be proficient in demonstrating it to their students.
3. Approach the administrative personnel of hemodialysis unit, in order to raise their awareness about the benefits of reflexology to patients on hemodialysis, and encouraging its use as an integral part of patient's care.

**Recommendation for further research:**

- Compare reflexology foot massage with other complementary medicine methods in relieving fatigue and leg cramps of patients on hemodialysis.
- Research on cost-effectiveness, gender and aging differences associated with reflexology.
- Evaluate the effects of foot reflexology on outcome variables other than fatigue and leg cramps.

**Table (1):** Frequency Distribution and Significance of Differences of Socio-Demographic and Clinical Characteristics among the Study and Control Groups of Patients on Hemodialysis.

Socio-demographic and Clinical characteristics	Study group (n=33)		Control group (n=33)		Significance level
	No.	%	No.	%	
<b>Age (years)</b>					$\chi^2=6.86$ P=0.077
20-	12	36.4	5	15.1	
30-	7	21.2	4	12.1	
40-	7	21.2	9	27.3	
50-≤60	7	21.2	15	45.5	
<b>Gender</b>					$\chi^2=0.0$ P=1.0
Male	20	60.6	20	60.6	
Female	13	39.4	13	39.4	
<b>Educational level</b>					$\chi^2=4.7$ P=0.319
Illiterate/read and write	4	12.1	7	21.2	
Primary	3	9.1	4	12.1	
Secondary	9	27.3	3	9.1	
Diploma	12	36.4	11	33.3	
University	5	15.2	8	24.3	
<b>Duration of hemodialysis in years</b>					$\chi^2=8.673$ MC=0.071
<1	0	0.0	5	15.1	
1-	11	33.4	9	27.3	
3-	8	24.2	12	36.4	
6-	8	24.2	3	9.1	
9≤	6	18.2	4	12.1	
<b>Inter- dialytic weight gain (kg)</b>					$\chi^2=3.481$ MC=0.372
0.5-<1.5	3	9.1	7	21.2	
1.5-<2.5	22	66.7	16	48.5	
2.5-<3.5	6	18.2	9	27.3	
≥3.5	2	6.1	1	3.0	

-  $\chi^2$ : Chi-Square test - FE: Fisher's Exact test -MC: Monte Carlo test  
 - \*level of significance = ≤0.05

**Table (2):** Frequency Distribution of Leg Cramps Intensity among the Study and Control Groups and Significance of Differences Before and After Reflexology Foot Massage Sub Sessions of Patients on Hemodialysis.

Leg cramp intensity		Immediately before session				Sig Chi-Square test	Immediately after session				Sig Chi-Square test
		Study group		Control group			Study group		Control group		
		No.	%	No	%		No.	%	No.	%	
1 <sup>st</sup> session	No	(n=21)		(n=17)		1.0	(n=21)		(n=17)		0.0001*
	Mild	0	0.0	0	0.0		18	85.7	1	5.9	
	Mod.	0	0.0	0	0.0		3	14.3	15	88.2	
	Severe	21	100.0	17	100.0		0	0.0	0	0	
2 <sup>nd</sup> session	No	(n=13)		(n=7)		0.791	(n=13)		(n=7)		0.0001*
	Mild	0	0.0	0	0.0		13	100.0	0	0.0	
	Mod.	3	23.1	2	28.6		0	0.0	4	57.1	
	Severe	10	76.9	5	71.4		0	0.0	3	42.9	
3 <sup>rd</sup> session	No	(n=12)		(n=8)		0.362	(n=12)		(n=8)		0.0001*
	Mild	0	0.0	0	0.0		9	75.0	1	12.5	
	Mod.	2	16.7	1	12.5		3	25.0	7	87.5	
	Severe	10	83.3	7	87.5		0	0.0	0	0.0	
4 <sup>th</sup> session		(n=5)		(n=8)			(n=5)		(n=8)		

	No	0	0.0	0	0.0		5	100.0	0	0.0	
	Mild	0	0.0	0	0.0		0	0.0	8	100.0	
	Mod.	0	0.0	2	25.0	0.628	0	0.0	0	0.0	0.005*
	Severe	5	100.0	6	75.0		0	0.0	0	0.0	
5 <sup>th</sup> session		(n=11)		(n=11)			(n=11)		(n=11)		
	No	0	0.0	0	0.0		9	81.8	0	0.0	
	Mild	0	0.0	0	0.0		2	18.2	9	81.8	
	Mod.	1	9.1	0	0.0	0.792	0	0.0	2	18.2	0.0001*
	Severe	10	90.9	11	100.0		0	0.0	0	0.0	
6 <sup>th</sup> session		(n=7)		(n=4)			(n=7)		(n=4)		
	No	0	0.0	0	0.0		5	71.4	0	0.0	
	Mild	0	0.0	0	0.0		2	28.6	4	100.0	
	Mod.	0	0.0	0	0.0	1.0	0	0.0	0	0.0	0.005*
	Severe	7	100.0	4	100.0		0	0.0	0	0.0	
7 <sup>th</sup> session		(n=5)		(n=9)			(n=5)		(n=9)		
	No	0	0.0	0	0.0		4	80.0	0	0.0	
	Mild	0	0.0	0	0.0		1	20.0	9	100.0	
	Mod.	0	0.0	0	0.0	1.0	0	0.0	0	0.0	0.0001*
	Severe	5	100.0	9	100.0		0	0.0	0	0.0	
8 <sup>th</sup> session		(n=6)		(n=15)			(n=6)		(n=15)		
	No	0	0.0	0	0.0		5	84.8	2	13.3	
	Mild	0	0.0	0	0.0		1	15.2	13	86.7	
	Mod.	1	16.7	0	0.0	0.402	0	0.0	0	0.0	0.009*
	Severe	5	83.3	15	100.0		0	0.0	0	0.0	
9 <sup>th</sup> session		(n=6)		(n=22)			(n=6)		(n=22)		
	No	0	0.0	0	0.0		6	100.0	7	31.8	
	Mild	0	0.0	0	0.0		0	0.0	15	68.2	
	Mod.	1	16.7	2	9.1	0.171	0	0.0	0	0.0	<0.0001*
	Severe	5	83.3	20	90.9		0	0.0	0	0.0	

-\*level of significance  $p = \leq 0.05$

**Sub session:** is a part of reflexology foot massage session done for only 5 minutes when leg cramps occur by applying pressure to solar plexus point, leg point and sciatic nerve point in the foot of the affected leg.

**Table (3):** Frequency Distribution of Weekly Leg Cramps Assessment Findings among the Study and Control Groups and Significance of Differences Before and After Reflexology Foot Massage Sessions of Patients on Hemodialysis.

Weekly leg cramps assessment findings		1 <sup>st</sup> assessment				2 <sup>nd</sup> assessment				3 <sup>rd</sup> assessment				4 <sup>th</sup> assessment					
		Study group (n=14)		Control group (n=12)		Sig. Chi-Square test	Study group (n=10)		Control group (n=6)		Sig. Chi-Square test	Study group (n=0)		Control group (n=11)		Study group (n=0)		Control group (n=20)	
		No.	%	No.	%		No.	%	No.	%		No.	%	No.	%	No.	%	No.	%
Leg cramp site	Right leg	10	71.4	7	58.3	0.532	7	70.0	2	33.3	0.068	0	0.0	5	45.5	0	0.0	10	50.0
	Left leg	3	21.4	2	16.7		3	30.0	1	16.7		0	0.0	2	18.2	0	0.0	4	20.0
	both	1	7.1	3	25.0		0	0.0	3	50.0		0	0.0	4	36.4	0	0.0	6	30.0
		<b>Sig. before and after for each group: study group <math>P_1 = 0.642</math> control group <math>P_1 = 0.535, P_2 = 0.805, P_3 = 0.901</math></b>																	
Cramp onset	Gradual	14	100.0	10	83.3	0.203	10	100.0	4	66.7	0.125	0	0.0	9	81.8	0	0.0	14	70.0
	Sudden	0	0.0	2	16.7		0	0.0	2	33.3		0	0.0	2	18.2	0	0.0	6	30.0

<b>Sig. before and after for each group: study group <sup>∞</sup>P1=-NA- control group P1=0.569, P2=1.0, P3=0.676</b>																			
Alleviating factors	Rubbing	11	78.6	10	83.3	0.124	8	80.0	1	16.7	0.035*	0	0.0	3	27.3	0	0.0	6	30.0
	Rubbing +dorsiflexion	3	21.4	2	16.7		2	20.0	5	83.3		0	0.0	9	81.8	0	0.0	14	70.0
<b>Sig. before and after for each group: study group <sup>∞</sup>P1=0.041* control group P1=1.0, P2=1.0, P3=0.676</b>																			
Duration (min)	2-	0	0.0	1	8.3		7	70.0	0	0.0	0.003*	0	0.0	0	0.0	0	0.0	0	0.0
	4-	13	92.9	8	66.7	0.401	3	30.0	4	66.7		0	0.0	6	54.5	0	0.0	10	50.0
	6-	1	7.1	2	16.7		0	0.0	0	0.0		0	0.0	0	0.0	0	0.0	4	20.0
	8-<10	0	0.0	1	8.3		0	0.0	2	33.3		0	0.0	5	45.5	0	0.0	6	30.0
<b>Sig. before and after for each group: study group <sup>∞</sup>P1=0.043* control group P1=0.308, P2=0.118, P3=0.433</b>																			
Frequency	One	1	7.1	0	0.0		8	80.0	1	16.7	0.021*	0	0.0	3	27.3	0	0.0	1	5.0
	Two	4	28.6	5	41.7	0.46	2	20.0	2	33.2		0	0.0	2	18.2	0	0.0	3	15.0
	Three	9	64.3	5	41.7		0	0.0	1	16.7		0	0.0	6	54.5	0	0.0	12	60.0
	Four	0	0.0	1	8.3		0	0.0	1	16.7		0	0.0	0	0.0	0	0.0	1	5.0
	Five or more	0	0.0	1	8.3		0	0.0	1	16.7		0	0.0	0	0.0	0	0.0	3	15.0
<b>Sig. before and after for each group: study group <sup>∞</sup>P1=0.006* control group P1=0.506, P2=0.175, P3=0.503</b>																			

-NA- Not applicable because all patients in the study group had sudden leg cramps onset  
 1<sup>st</sup> assessment: the week before first contact, 2<sup>nd</sup> assessment: after 3 sessions, 3<sup>rd</sup> assessment: after 6 sessions & 4<sup>th</sup> assessment: after 9 sessions  
 -sig. for each group: p-value for Marginal Homogeneity test or Mac Nemar test - \*level of significance p = ≤0.05  
<sup>∞</sup>P1: significance between 1<sup>st</sup> assessment and 2<sup>nd</sup> assessment \*P2: significance between 1<sup>st</sup> assessment and 3<sup>rd</sup> assessment, \*P3: significance between 1<sup>st</sup> assessment and 4<sup>th</sup> assessment

**Table (4):** Effect of Leg Cramps on Sleep Pattern among the Study and Control Groups and Significance of Differences Before and After Reflexology Foot Massage Sessions of Patients on Hemodialysis.

Effect of leg cramps on sleep pattern	1 <sup>st</sup> assessment					2 <sup>nd</sup> assessment					3 <sup>rd</sup> assessment				4 <sup>th</sup> assessment				
	Study group (n=14)		Control group (n=12)		Sig. Chi-Square test	Study group (n=10)		Control group (n=6)		Sig. Chi-Square test	Study group (n=0)		Control group (n=11)		Study group (n=0)		Control group (n=20)		
	No.	%	No.	%		No.	%	No.	%		No.	%	No.	%	No.	%	No.	%	
Patient's sleep description	Deep	2	14.3	0	0.0	0.483	9	90.0	0	0.0	0.001*	0	0.0	0	0.0	0	0.0	0	0.0
	Not deep	12	85.7	12	100.0		1	10.0	6	100.0		0	0.0	11	100.0	0	0.0	20	100.0
<b>Sig. before and after for each group: study group <sup>∞</sup>P1=0.0005* control group <sup>∞</sup>P1=-□NA-, *P2=-□NA-, *P3=-□NA-</b>																			
Sleep quality	Good	3	21.4	1	8.3	0.598	10	100.0	1	16.7		0	0.0	1	9.1	0	0.0	2	10.0
	Adequate	11	78.6	11	91.7		0	0.0	4	66.7	0.002*	0	0.0	9	81.8	0	0.0	18	90.0
	Poor	0	0.0	0	0.0		0	0.0	1	16.7		0	0.0	1	9.1	0	0.0	0	0.0
<b>Sig. before and after for each group: study group <sup>∞</sup>P1=0.0002* control group <sup>∞</sup>P1=0.279, *P2=0.56, *P3=1.0</b>																			
Wake up from sleep	No	0	0.0	0	0.0	--	0	0.0	0	0.0	--	0	0.0	0	0.0	0	0.0	0	0.0
	Yes	14	100.0	12	100.0		10	100.0	6	100.0		0	0.0	11	100.0	0	0.0	20	100.0
<b>Sig. before and after for each group: study group <sup>∞</sup>P1=-□NA- control group <sup>∞</sup>P1=-□NA-, *P2=-∞NA-, *P3=-□NA-</b>																			

Number of waking up	Once	14	100.0	11	91.7	0.462	10	100.0	5	83.3	0.375	0	0.0	10	90.9	0	0.0	20	100.0
	Twice	0	0.0	1	8.3		0	0.0	1	16.7		0	0.0	1	9.1	0	0.0	0	0.0
<b>Sig. before and after for each group: study group</b> <sup>∞</sup> P1=-NA- <b>control group</b> <sup>∞</sup> P1=1.0, <sup>*</sup> P2=1.0, <sup>*</sup> P3=1.0																			
Sleeping hours affected by leg cramps	Yes	9	64.3	11	91.7	0.17	1	10.0	5	83.3	0.008*	0	0.0	9	81.8	0	0.0	18	90.0
	No	5	35.7	1	8.3		9	90.0	1	16.7		0	0.0	2	18.2	0	0.0	2	10.0
<b>Sig. before and after for each group: study group</b> <sup>∞</sup> P1=0.01* <b>control group:</b> <sup>∞</sup> P1=1.0, <sup>*</sup> P2=0.59, <sup>*</sup> P3=1.0																			
Effect of Leg cramps on of sleep's extent	Not at all	1	7.1	1	8.3		2	20.0	0	0.0	0	0.0	1	9.1	0	0.0	1	5.0	
	A little	4	28.6	5	41.7	0.836	7	70.0	1	16.7	0.014*	0	0.0	5	45.5	0	0.0	12	60.0
	Somewh at	9	64.3	6	50.0		1	10.0	5	83.3		0	0.0	5	45.5	0	0.0	7	35.0
<b>Sig. before and after for each group: study group</b> <sup>∞</sup> P1=0.029* <b>control group:</b> <sup>∞</sup> P1=0.372, <sup>*</sup> P2=0.977, <sup>*</sup> P3=0.599																			

- #NA-, Not applicable because all patients in the control group described their sleep as not deep
- ∞NA- Not applicable because all patients in the study and control groups waked up from sleep
- <sup>∞</sup>NA- Not applicable because all patients in the study group waked up from sleep once
- NA Not applicable because all patients in the control group didn't have trouble return to sleep
- 1<sup>st</sup> assessment: the week before first contact, 2<sup>nd</sup> assessment: after 3 sessions, 3<sup>rd</sup> assessment: after 6 sessions & 4<sup>th</sup> assessment: after 9 sessions
- sig. for each group: p-value for Marginal Homogeneity test or Mac Nemar test - \*level of significance p = ≤0.05
- <sup>∞</sup>P1: significance between 1<sup>st</sup> assessment and 2<sup>nd</sup> assessment <sup>\*</sup>P2: significance between 1<sup>st</sup> assessment and 3<sup>rd</sup> assessment, <sup>\*</sup>P3: significance between 1<sup>st</sup> assessment and 4<sup>th</sup> assessment

**Table (5):** Effect of Leg Cramps on Physical Activity among the Study and Control Groups and Significance of Differences Before and After Reflexology Foot Massage Sessions of Patients on Hemodialysis.

Effect of leg cramps on physical activity		1 <sup>st</sup> assessment					2 <sup>nd</sup> assessment					3 <sup>rd</sup> assessment				4 <sup>th</sup> assessment			
		Study group (n=14)		Control group (n=12)		Sig. Chi-Square test	Study group (n=10)		Control group (n=6)		Sig. Chi-Square test	Study group (n=0)		Control group (n=11)		Study group (n=0)		Control group (n=20)	
		No.	%	No.	%		No.	%	No.	%		No.	%	No.	%	No.	%	No.	%
Sports	Not at all	12	85.7	11	91.7		10	100.0	5	83.3		0	0.0	9	81.8	0	0.0	17	85.0
	Somewh at	1	7.1	0	0.0	1.0	0	0.0	1	16.7	0.375	0	0.0	1	9.1	0	0.0	2	10.0
	Much	1	7.1	1	8.3		0	0.0	0	0.0		0	0.0	1	9.1	0	0.0	1	5.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.459 <b>control group:</b> <sup>∞</sup> P1=0.282, <sup>*</sup> P2=0.56, <sup>*</sup> P3=0.504																			
Stair climbing	Not at all	12	85.7	11	91.7		10	100.0	5	83.3		0	0.0	9	81.8	0	0.0	16	80.0
	Somewh at	1	7.1	0	0.0	1.0	0	0.0	1	16.7	0.375	0	0.0	1	9.1	0	0.0	2	10.0
	Much	1	7.1	1	8.3		0	0.0	0	0.0		0	0.0	1	9.1	0	0.0	2	10.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.459 <b>control group:</b> <sup>∞</sup> P1=0.282, <sup>*</sup> P2=0.56, <sup>*</sup> P3=0.511																			
walking	Not at all	12	85.7	9	75.0		10	100.0	3	50.0		0	0.0	8	72.7	0	0.0	14	70.0
	Somewh at	1	7.1	0	0.0	0.453	0	0.0	3	50.0	0.036*	0	0.0	1	9.1	0	0.0	1	5.0
	Much	1	7.1	3	25.0		0	0.0	0	0.0		0	0.0	2	18.2	0	0.0	5	25.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.019* <b>control group:</b> <sup>∞</sup> P1=0.459, <sup>*</sup> P2=0.544, <sup>*</sup> P3=0.731																			
sitting	Not at all	8	57.1	7	58.3		8	80.0	0	0.0		0	0.0	5	45.5	0	0.0	9	45.0
	Somewh at	4	28.6	0	0.0	0.098	1	20.0	1	16.7	0.004*	0	0.0	1	9.1	0	0.0	2	10.0
	Much	2	14.3	5	41.7		1	20.0	5	83.3		0	0.0	5	45.5	0	0.0	9	45.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.034* <b>control group:</b> <sup>∞</sup> P1=0.47, <sup>*</sup> P2=0.524, <sup>*</sup> P3=0.576																			
Standing	Not at all	10	71.4	9	75.0		10	100.0	3	50.0		0	0.0	7	63.6	0	0.0	14	70.0
	Somewh at	2	14.3	0	0.0	0.348	0	0.0	3	50.0	0.036*	0	0.0	1	9.1	0	0.0	1	5.0
	Much	2	14.3	3	25.0		0	0.0	0	0.0		0	0.0	3	27.3	0	0.0	5	25.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.019* <b>control group:</b> <sup>∞</sup> P1=0.18, <sup>*</sup> P2=0.546, <sup>*</sup> P3=0.731																			

- 1<sup>st</sup> assessment: the week before first contact, 2<sup>nd</sup> assessment: after 3 sessions, 3<sup>rd</sup> assessment: after 6 sessions & 4<sup>th</sup> assessment: after 9 sessions
- -sig. for each group: p-value for Marginal Homogeneity test or Mac Nemar test - \*level of significance p = ≤0.05
- <sup>∞</sup>P1: significance between 1<sup>st</sup> assessment and 2<sup>nd</sup> assessment \*P2: significance between 1<sup>st</sup> assessment and 3<sup>rd</sup> assessment, \*P3: significance between 1<sup>st</sup> assessment and 4<sup>th</sup> assessment

**Table (6):** Effect of Leg Cramps on Emotional Well-Being among the Study and Control Groups and Significance of Differences Before and After Reflexology Foot Massage Sessions of Patients on Hemodialysis.

Effect of leg cramps on emotional well-being		1 <sup>st</sup> assessment					2 <sup>nd</sup> assessment					3 <sup>rd</sup> assessment				4 <sup>th</sup> assessment			
		Study group (n=14)		Control group (n=12)		Sig. Chi-Square test	Study group (n=10)		Control group (n=6)		Sig. Chi-Square test	Study group (n=0)		Control group (n=11)		Study group (n=0)		Control group (n=20)	
		No.	%	No.	%		No.	%	No.	%		No.	%	No.	%	No.	%	No.	%
Little interest in work/activity	Not at all	0	0.0	1	8.3	0.651	7	70.0	0	0.0	0.001*	0	0.0	2	18.2	0	0.0	2	10.0
	Somewhat	4	28.6	1	8.3		3	30.0	0	0.0		0	0.0	3	27.3	0	0.0	4	20.0
	Much	9	64.3	9	75.0		0	0.0	6	100.0		0	0.0	5	45.5	0	0.0	12	60.0
	Very much	1	7.1	1	8.3		0	0.0	0	0.0		0	0.0	1	9.1	0	0.0	2	10.0
Sig. before and after for each group study group <sup>∞</sup> P1=0.0007* control group: <sup>∞</sup> P1=0.615, *P2=0.487, *P3=0.812																			
Feeling depresses	Not at all	0	0.0	1	8.3	0.823	8	80.0	0	0.0	0.001*	0	0.0	2	18.2	0	0.0	2	10.0
	Somewhat	4	28.6	2	16.7		2	20.0	0	0.0		0	0.0	3	27.3	0	0.0	5	25.0
	Much	9	64.3	8	66.7		0	0.0	6	100.0		0	0.0	5	45.5	0	0.0	11	55.0
	Very much	1	7.1	1	8.3		0	0.0	0	0.0		0	0.0	1	9.1	0	0.0	2	10.0
Sig. before and after for each group study group <sup>∞</sup> P1=0.0003* control group: <sup>∞</sup> P1=0.463, *P2=0.757, *P3=0.929																			
Feeling angry	Not at all	0	0.0	1	8.3	0.793	5	50.0	0	0.0	0.001*	0	0.0	1	9.1	0	0.0	1	5.0
	Somewhat	3	21.4	1	8.3		5	50.0	0	0.0		0	0.0	3	27.3	0	0.0	5	25.0
	Much	10	71.4	9	75.0		0	0.0	6	100.0		0	0.0	6	54.5	0	0.0	12	60.0
	Very much	1	7.1	1	8.3		0	0.0	0	0.0		0	0.0	1	9.1	0	0.0	2	10.0
Sig. before and after for each group study group <sup>∞</sup> P1=0.0009* control group: <sup>∞</sup> P1=0.615, *P2=0.669, *P3=0.678																			
Feeling frustration	Not at all	0	0.0	1	8.3	0.651	7	70.0	0	0.0	0.001*	0	0.0	1	9.1	0	0.0	1	5.0
	Somewhat	4	28.6	1	8.3		3	30.0	0	0.0		0	0.0	3	27.3	0	0.0	5	25.0
	Much	9	64.3	9	75.0		0	0.0	6	100.0		0	0.0	6	54.5	0	0.0	12	60.0

*Effect of Reflexology Foot Massage on Leg Cramps for Patients on Hemodialysis.*

	Very much	1	7.1	1	8.3		0	0.0	0	0.0		0	0.0	1	9.1	0	0.0	2	10.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.0007* <b>control group:</b> <sup>∞</sup> P1=0.615, <sup>*</sup> P2=0.669, <sup>*</sup> P3=0.678																			
Low mood	Not at all	0	0.0	1	8.3		5	50.0	0	0.0		0	0.0	1	9.1	0	0.0	1	5.0
	Somewhat	4	28.6	1	8.3	0.651	5	50.0	0	0.0	0.0001*	0	0.0	3	27.3	0	0.0	5	25.0
	Much	9	64.3	9	75.0		0	0.0	6	100.0		0	0.0	6	54.5	0	0.0	12	60.0
	Very much	1	7.1	1	8.3		0	0.0	0	0.0		0	0.0	1	9.1	0	0.0	2	10.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.002* <b>control group:</b> <sup>∞</sup> P1=0.615, <sup>*</sup> P2=0.669, <sup>*</sup> P3=0.678																			
Being tearful	Not at all	0	0.0	1	8.3		6	60.0	0	0.0		0	0.0	1	9.1	0	0.0	1	5.0
	Somewhat	4	28.6	2	16.7	0.823	4	40.0	0	0.0	0.0001*	0	0.0	3	27.3	0	0.0	5	25.0
	Much	9	64.3	8	66.7		0	0.0	6	100.0		0	0.0	6	54.5	0	0.0	12	60.0
	Very much	1	7.1	1	8.3		0	0.0	0	0.0		0	0.0	1	9.1	0	0.0	2	10.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.001* <b>control group:</b> <sup>∞</sup> P1=0.463, <sup>*</sup> P2=0.931, <sup>*</sup> P3=0.930																			

1<sup>st</sup> assessment: the week before first contact, 2<sup>nd</sup> assessment: after 3 sessions, 3<sup>rd</sup> assessment: after 6 sessions & 4<sup>th</sup> assessment: after 9 sessions

-sig. for each group: p-value for Marginal Homogeneity test or Mac Nemar test - \*level of significance p = ≤0.05 <sup>∞</sup>P1: significance between 1<sup>st</sup> assessment and 2<sup>nd</sup> assessment <sup>\*</sup>P2: significance between 1<sup>st</sup> assessment and 3<sup>rd</sup> assessment, <sup>\*</sup>P3: significance between 1<sup>st</sup> assessment and 4<sup>th</sup> assessment

**Table (7):** Effect of Leg Cramps on Social Activities among the Study and Control Groups and Significance of Differences Before and After Reflexology Foot Massage Sessions of Patients on Hemodialysis.

Effect of leg cramps on social activities	1 <sup>st</sup> assessment					2 <sup>nd</sup> assessment					3 <sup>rd</sup> assessment				4 <sup>th</sup> assessment				
	Study group (n=14)		Control group (n=12)		Sig. Chi-Square test	Study group (n=10)		Control group (n=6)		Sig. Chi-Square test	Study group (n=0)		Control group (n=11)		Study group (n=0)		Control group (n=20)		
	No.	%	No.	%		No.	%	No.	%		No.	%	No.	%	No.	%	No.	%	
Get out from home	Not at all	8	57.1	6	50.0		9	90.0	1	16.7		0	0.0	5	45.4	0	0.0	9	45.0
	Somewhat	6	42.9	5	41.7	0.559	1	10.0	2	33.3	0.008*	0	0.0	3	27.3	0	0.0	7	35.0
	Much	0	0.0	1	8.3		0	0.0	3	50.0		0	0.0	3	27.3	0	0.0	4	20.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.027* <b>control group:</b> <sup>∞</sup> P1=0.114, <sup>*</sup> P2=0.461, <sup>*</sup> P3=0.676																			
Participate in social activities	Not at all	6	42.9	6	50.0		9	90.0	1	16.7		0	0.0	5	45.4	0	0.0	9	45.0
	Somewhat	8	57.1	4	33.3	0.257	1	10.0	2	33.3	0.008*	0	0.0	3	27.3	0	0.0	7	35.0
	Much	0	0.0	2	16.7		0	0.0	3	50.0		0	0.0	3	27.3	0	0.0	4	20.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.033* <b>control group:</b> <sup>∞</sup> P1=0.0254, <sup>*</sup> P2=0.822, <sup>*</sup> P3=0.956																			
Participate in household chores	Not at all	6	42.9	6	50.0		9	90.0	1	16.7		0	0.0	5	45.4	0	0.0	9	45.0
	Somewhat	7	50.0	4	33.3	0.641	1	10.0	2	33.3	0.008*	0	0.0	3	27.3	0	0.0	7	35.0
	Much	1	7.1	2	16.7		0	0.0	3	50.0		0	0.0	3	27.3	0	0.0	4	20.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.041* <b>control group:</b> <sup>∞</sup> P1=0.254, <sup>*</sup> P2=0.822, <sup>*</sup> P3=0.956																			
Accomplish hard to work	Not at all	6	42.9	6	50.0		9	90.0	1	16.7		0	0.0	5	45.4	0	0.0	9	45.0

	Somewh at Much	7	50.0	4	33.3	0641	1	10.0	2	33.3	0.008*	0	0.0	3	27.3	0	0.0	7	35.0
	Much	1	7.1	2	16.7		0	0.0	3	50.0		0	0.0	3	27.3	0	0.0	4	20.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.021* <b>control group:</b> <sup>∞</sup> P1=0.254, *P2=0.822, *P3=0.956																			
Meet demands	Not at all	6	42.9	6	50.0		9	90.0	1	16.7		0	0.0	5	45.4	0	0.0	9	45.0
	Somewh at Much	7	50.0	4	33.3	0641	1	10.0	2	33.3	0.008*	0	0.0	3	27.3	0	0.0	7	35.0
	Much	1	7.1	2	16.7		0	0.0	3	50.0		0	0.0	3	27.3	0	0.0	4	20.0
<b>Sig. before and after for each group study group</b> <sup>∞</sup> P1=0.046* <b>control group:</b> <sup>∞</sup> P1=0.254, *P2=0.822, *P3=0.956																			

1<sup>st</sup> assessment: the week before first contact, 2<sup>nd</sup> assessment: after 3 sessions, 3<sup>rd</sup> assessment: after 6 sessions & 4<sup>th</sup> assessment: after 9 sessions

-sig. for each group: p-value for Marginal Homogeneity test or Mac Nemar test -\*level of significance  $p \leq 0.05$   
<sup>∞</sup>P1: significance between 1<sup>st</sup> assessment and 2<sup>nd</sup> assessment \*P2: significance between 1<sup>st</sup> assessment and 3<sup>rd</sup> assessment, \*P3: significance between 1<sup>st</sup> assessment and 4<sup>th</sup> assessment

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