Effect of Relaxation Exercises versus Foot Reflexology on Hypertension in Postmenopausal Women

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ABSTRACT

Back ground: Hypertension after menopause sets women up for an increased risk of negative cardiovascular outcomes. Reflexology is a systematic practice of applying some pressure to specific points on the feet and hands give impacts on the health of related parts of the body. A variety of relaxation techniques exist, which aim to relive stress and reduce blood pressure. **Purpose:** The present study was conducted to compare between the effects of relaxation exercises versus foot reflexology on decreasing hypertension in postmenopausal women. **Subjects and Methods**: Thirty women diagnosed with postmenopausal hypertension. Their age ranged from 50 - 65 years. they were assigned randomly into two groups of equal number (A and B). Group (A) consisted of 15 patients who received foot reflexology combined with antihypertensive drugs while group (B) consisted of 15 patients who received relaxation exercises combined with antihypertensive drugs. The treatment program was conducted for 30 min (each foot 15 min) 3 times per week for 6 weeks. **Results:** The results revealed significant decrease in systolic and diastolic blood pressure as well as blood cortisol level for both groups (A and B) in favor of group (B). **Conclusion:** It could be concluded that relaxation exercises are more effective than foot reflexology in decreasing hypertension in postmenopausal women.

Key Words: Hypertension, Postmenopausal women, Foot reflexology, Relaxation exercises.

INTRODUCTION

Blood pressure is the pressure exerted on the walls of the arteries during ventricular systole and diastole which is affected by factors such as cardiac output, blood vessel elasticity, volume, velocity, viscosity of the blood and peripheral resistance **(1).**

Hypertension can be diagnosed as systolic blood pressure ≥ 140 mm Hg and/or diastolic ≥ 90 mm Hg and/or patients receive antihypertensive medications. Hypertension is an important risk factor for cardiovascular disease **(2).**

Blood pressure is typically lower in premenopausal women than in men. However, after menopause, the prevalence of hypertension in women is higher than it is in men. Hypertension is a major risk factor for cardiovascular disease in women and men, but cardiovascular disease is the leading cause of death in women. Furthermore, there is evidence that blood pressure may not be as well-controlled in women as in men, despite the fact that most women adhere better to their therapeutic regimens and medications than do men, and have their blood pressures measured more frequently than do men **(3).**

Relaxation increases the secretion of endorphin hormone and decreases the secretion of adrenalin hormone. Besides, it improves blood circulation and decreases anxiety and stress by creating a positive attitude and improving brain function. Relaxation also increases the cellular energy and one's confidence by relieving anxiety. Therefore, it balances the sugar and blood pressure **(4).**

Reflexology is a complementary (alternative medicine) where massaging pressure is applied to parts of the feet (or hands) to promote a beneficial effect on other parts of the body. The technique is considered to induce natural healing. Reflexology is based on the idea that there are Zones or reflexes in the feet and hands, which correspond to every part, gland and organ of the body **(5).**

It was hypothesized that there are no differences between the effect of relaxation exercises and foot reflexology in decreasing hypertension in postmenopausal women

MATERIALS AND METHODS

This study was carried out upon thirty women diagnosed with postmenopausal hypertension.They were selected from the Out-Patient Clinic of Misr Elhorra Hospital in Menia and Faculty of Physical therapy, Deraya University on the following criteria:

A) Inclusion criteria:

1. Thirty women diagnosed with postmenopausal hypertension.
2. Their age ranged from 50-65 years.
3. Their body mass index didn't exceed 30 kg/m^2.
4. their systolic blood pressure ranged from 135 – 150 mmHg and diastolic blood pressure ranged from 80 – 95 mmHg

B) Exclusion criteria:

Any participant was excluded if she met one of the following criteria:

1. Foot ulcer.
2. Foot infection.
3. Ischemic heart disease.
4. The first 3-6 months after a heart attack or stroke.

Design of study:

Thirty women diagnosed with postmenopausal hypertension who met the previous criteria were randomly assigned into two groups of equal number (A and B) using sealed envelope. This study extend from March 2019 to December 2019.

Each participant of both groubs (A&B) signed aconstant form before participate in the study.

- **Group (A):** consisted of 15 patients who received foot reflexology 3 times per week for 6 weeks.
- **Group (B):** consisted of 15 patients who received relaxation exercises 3 times per week for 6 weeks.

II. Materials:

1- Weight-height scale.
2- Stethoscope and sphygmomano-meter.
3- Syringes, alcohol and cotton
4- Plinth and pillow

III. Methods

A) For evaluation:

1- History taking:

Detailed medical history was taken from each participant before starting the study to confirm there were no any contra-indications that interferes the study. All data and information of each female would be recorded in a recording sheet.

2- Weight and height measurement:

The weight and height of each participant was measured while the women were wearing light clothes and bare feet, to calculate the body mass index before the study according to the following equation:

$$\text{BMI} = \frac{Weight\ (kg)}{Height^2\ (m^2)}$$

3- Blood pressure assessment:

A Diagnosis of all participants in both groups (A and B) were carried out by the internal medicine physician. Assessment of both systolic & diastolic blood pressure was done before and after the treatment by using the mercury sphygmomanometer.

Every participant was positioned in a relaxed sitting position. The cuff was wrapped around the upper arm with the cuff's lower edge one inch above the anti-cubital fossa.

The stethoscope's bell was pressed lightly over the brachial artery just below the cuff's edge. Then, cuff was inflated to 180 mmHg. After that, the air was released.

The researcher was listening with the stethoscope and simultaneously observed the sphygmomanometer. The first knocking sound (Korotkoff) was the subject's systolic pressure and when the knocking sound disappears, the diastolic pressure was recorded. This measurement was repeated three times and the mean was considered the data

4) Blood cortisol level:

Every participants of both groups (A and B) was asked to lie in half lying position, with well supported back and arm .The anti-cubital area was cleaned by alcohol. Blood sample of about 5cm

was drawn at the morning (at 8 clock) before breakfast from the anti-cubital vein. Blood sample was drawn before and after the treatment program for all participants by disposable sterile syringe using vienpunctuer and then collected in a sterilized tube to determine plasma cortisol level for each participant.

B) For treatment:

Foot reflexology combined with antihypertensive drugs for group (A):

Each participants of group (A) was advised to wear comfortable and light clothes and assume the relaxed supine lying position with her feet rested on the plinth in a quiet room. First, the patient was asked to remove both the shoes and socks in order to receive the treatment program. Then both feet of the patient were inspected for any broken or cuts skin.

The treatment session started with warm-up by washing of the entire sole with warm water. This helps to enhance over all relaxation, relax the feet, and prepares the feet for reflexology session.Then,the foot was massaged and included 5min of light pressure and light stroking using the whole hand on the dorsal and plantar surfaces of each foot relax the patient.

Then reflexology technique was applied by using the mixture of thumb walking and finger pivot techniques to the base of the toes and the foot that correspond with the reflex zones.

The pressure was done gently on the following points **(6) (Fig.1).**

1. Solar plexus point:

It is located just below the ball of both feet, at the midline. This point connects to the entire nervous system and can stimulate a profound relaxation effect as well as, minimizes both of stress and anxiety, The solar plexus is highly affected by stress so releasing this reflex point has been known to decrease stress levels as well as increase the body's tolerance for stress.

2. Pituitary reflex point:

It represents the pituitary gland, it is located exactly in the planter aspect of the center of hallux (big toe) of both feet. It is known as the master gland as it regulates the entire endocrine system.

3. Heart reflex point:

It is located on the bottom of the big toe of the planter aspect of both feet. This point improves the regulation of the heart and make the heart pump more efficiently, also, improves the physiological and spiritual health.

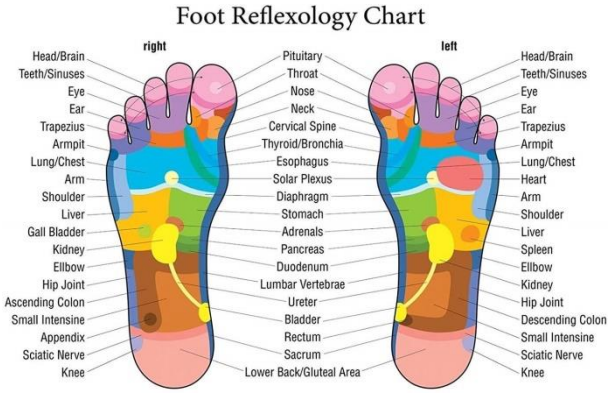
4. Adrenal reflex point:

It is located at the base of the second and third metatarsal bones of both feet (The metatarsal bones are the long bones from the toes to the arch, the first metatarsal bone being the long bone connecting to the big toe, the second one next to the big toe). The adrenal cortex produces hormones that regulate levels of fluids and electrolytes.

5. Kidney reflex point:

It is located on the middle of the arch of both feet close to the base of the 2nd metatarsals. The Kidney point is one of the most important points to massage for hypertension. That's because it helps to boost the Kidney Qi, harmonize

the Kidney meridian, and notify kidney deficiencies that may be at the root of elevated blood pressure. As well, those suffering from secondary hypertension related to the kidneys will also benefit from this point. Harmonizing the Kidney meridian helps to support kidney function. Foot reflexology sessions were conducted for 30 min (each foot 15 min) twice a week for 6 weeks.



(Fig.1): Foot Reflexology Chart

Relaxation exercise combined with antihypertensive drugs for group (B):

Every participant of group (B) was asked to evacuate her bladder to be more relaxed then she a positioned in a relaxed position. Relaxation techniques were applied for all participants of group (B) as the following:

1. Deep breathing exercises:

Each participant was asked to take a deep breath from her nose slowly and make her abdomen like a balloon and then, to count of four, then she was asked to expire the air from her mouth with a sigh. This exercise was repeated four times the pattern of deep breath, and expired to a count of four each, brought her breaths down to a calm and rhythmic pattern **(7).**

2.Meditation (Progressive muscle relaxation):

First, asking the patient to tense all of the muscles of the face, including forehead, cheeks, mouth, and upper neck. Then release with full awareness. Therapist notice the relaxation. Gently roll the head from side to side, with awareness of the tightening muscles, and the feeling of release. Tighten the shoulders, pulling them upwards and forwards. Then release. Tense the entire right arm, from the shoulder down through the fingers. Do this without making a fist or lifting your arm off of the floor. Allow your attention to be deep inside the arm, not just on the surface. Then release slowly, with awareness. Tense the left arm in the same way, and observe the release. Gently tense the muscles of the chest and the abdomen, while continuing to breathe without holding the breath. Then release. Tense and release the right hips and the buttocks. Tense and release the right leg, down through the feet and toes in the same way that the right arm was tensed and released. Tense and release the left hips and buttocks. Tense and release the left leg. While no longer tensing any muscles, allow your attention to drift back up through the legs, through the abdomen and chest, through the arms, and back to the face **(8).**

Statistical analysis

- Results were expressed as mean ± standard deviation.
- Test of normality, Kolmogorov-Smirnov test was used to measure the distribution of data measured at pre-treatment.

- Accordingly, comparison between normally distributed variables in the two groups was performed using unpaired t test. Analysis of covariance (ANCOVA) test was used to compare the pre-treatment values of the two groups and on the same time between post-treatment values on controlling the effect of pre-treatment value.
- Comparison between pre- and post-treatment data in the same group was performed using paired t test.
- Statistical Package for Social Sciences (SPSS) computer program (version 19 windows) was used for data analysis. P value ≤ 0.05 was considered significant.

RESULTS

I- General characteristics of both groups (A&B):

The mean values (± SD) of age, weight, height and BMI in group (A) were (56.60 ± 4.19 yrs), (71.27 ± 3.39 kg), (159.33 ± 3.90 cm) and (28.06 ± 0.76 kg/m2) respectively. While the mean values were (57.00 ± 3.96 yrs), (73.27 ± 3.31 kg), (160.40 ± 3.91 cm) and (28.47 ± 0.67 kg/m2) respectively in group (B). There was no statistical significant difference between the two groups as regards age (t= -0.269, p= 0.790), weight (t= -1.636, p= 0.113), height (t= -0.748, t= 0.461) and BMI (t= -1.554, p= 0.131) **(Table 1).**

Table (1): General characteristics of the both groups (A and B) before treatment:

Variables	Group A (n= 15)	Group B (n= 15)	t value	P value
Age (yrs.)	56.60 ± 4.19	57.00 ± 3.96	-0.269	0.790 (NS)
Weight (kg.)	71.27 ± 3.39	73.27 ± 3.31	-1.636	0.113 (NS)
Height (cm)	159.33 ± 3.90	160.40 ± 3.91	-0.748	0.461 (NS)
BMI (Kg/m2)	28.06 ± 0.76	28.47 ± 0.67	-1.554	0.131 (NS)

Data are expressed as mean ± SD. NS= p> 0.05= not significant.

II- Systolic blood pressure:

Within group comparison (intra group comparison):

In group (A), there was a statistical significant decrease in the mean value of systolic blood pressure measured at post-treatment (137.33 ± 4.58) (mmHg) compared to its corresponding value measured at pre-treatment (141.33 ± 3.99) (mmHg) with t value = 4.583 and p value = 0.001 **(Table 2).**

Also, in group (B), there was a statistical significant decrease in the mean value of systolic blood pressure measured at post-treatment (133.33 ± 4.50) (mmHg) when compared with its corresponding value measured at pre-treatment (140.67 ± 3.20) (mmHg) with t value = 7.643 and p value = 0.001 **(Table 2).**

The percent decrease in systolic blood pressure level in both groups (A) and (B) were 2.83% and 5.22% respectively **(Table2).**

Between groups comparison:

Comparised systolic blood pressure in both groups (A and B) before treatment shawed statistical no significant difference between the two groups (F= 0.255 and p= 0.618) **(Table**

2). while post-treatment the results revealed that there was a statistical significant decrease in group (B) when compared to its corresponding level in group (A) (F= 7.095 and p= 0.013) **(Table 2).**

Table (2): Comparison between mean values of systolic blood pressure (mmHg) in the two studied groups measured at pre- and post-treatment:

Data of assesment	Group A (n= 15)	Group B (n= 15)	F value	P value
Pre-treatment	141.33 ± 3.99	140.67 ± 3.20	0.255	0.618(NS)
Post-treatment	137.33 ± 4.58	133.33 ± 4.50	7.095	0.013 (S)
Mean difference	4.00	7.34		
% change	2.83 ↓↓	5.22 ↓↓		
t value	4.583	7.643		
p value	0.001 (S)	0.001 (S)		

Data are expressed as mean ± SD. F value= ANCOVA test. t value= paired t test.
NS= p> 0.05= not significant. S= p≤ 0.05= significant.

III- Diastolic blood pressure:

Within group comparison (intra group comparison):

In group (A), there was a statistical significant decrease in the mean value of diastolic blood pressure measured at post-treatment (85.67 ± 2.58) (mmHg) compared to its corresponding value measured at pre-treatment (88.00 ± 3.16) (mmHg) with t value= 3.500 and p value = 0.004 **(Table 3).**

Also, in group (B), there was a statistical significant decrease in the mean value of diastolic blood pressure measured at post-treatment (84.00 ± 2.07) (mmHg) when compared with its corresponding value measured at pre-treatment (87.67 ± 3.20) (mmHg) with t value= 6.205 and p value = 0.001 **(Table 3).**

The percent decrease in diastolic blood pressure level in both groups (A) and (B) were 2.65% and 4.19%, respectively **(Table 3).**

Between groups comparison:

Comparised diastolic blood pressure in both groups (A and B) before treatment shawed statistical no significant difference between the two groups (F= 0.082 and p= 0.776) **(Table 3).** While the results revealed that there was a statistical significant decrease in group (B) when compared to its corresponding level in group (A) (F= 5.157 and p= 0.031) **(Table 3).**

Table (3): Comparison between mean values of diastolic blood pressure (mmHg) in the two studied groups measured at pre- and post-treatment:

Data of assessment	Group A (n= 15)	Group B (n= 15)	F value	P value
Pre-treatment	88.00 ± 3.16	87.67 ± 3.20	0.082	0.776(NS)
Post-treatment	85.67 ± 2.58	84.00 ± 2.07	5.157	0.031 (S)
Mean difference	2.33	3.67		
% change	2.65 ↓↓	4.19 ↓↓		
t value	3.500	6.205		
p value	0.004 (S)	0.001 (S)		

Data are expressed as mean ± SD. F value= ANCOVA test. t value= paired t test.

IV- Cortisol

Within group comparison (intra group comparison):

In group (A), there was a statistical significant decrease in the mean value of Also, in group (B), there was a statistical significant decrease in the mean value of cortisol level measured at post-treatment (15.35 ± 2.41) when compared with its corresponding value measured at pre-treatment (18.93 ± 3.74) with t value= 7.035 and p value = 0.001 **(Table 4).**

The percent decrease in cortisol level in both groups (A) and (B) were 4.21% and 18.91%, respectively **(Table 4).**

cortisol level measured at post-treatment (17.73 ± 3.58) when compared to its corresponding value measured at pre-treatment (18.51 ± 3.96) with t value= 4.605 and p value = 0.001 **(Table 4).**

Between groups comparison:

Comparised cortisol in both groups (A and B) before treatment shawed statistical no significant difference between the two groups (F= 0.089 & p= 0.767) **(Table 4).**

The results revealed that there was a statistical significant decrease in its level in group B when compared to its corresponding level in group A (F= 45.041 and p= 0.001) **(Table 4).**

Table (4): Comparison between mean values of cortisol level in the two studied groups measured at pre- and post-treatment:

Data of assessment	Group A (n= 15)	Group B (n= 15)	F value	P value
Pre-treatment	18.51 ± 3.96	18.93 ± 3.74	0.089	0.767(NS)
Post-treatment	17.73 ± 3.58	15.35 ± 2.41	45.041	0.001(S)
Mean difference	0.78	3.58		
% change	4.21 ↓↓	18.91 ↓↓		
t value	4.605	7.035		
p value	0.001 (S)	0.001 (S)		

Data are expressed as mean ± SD. F value= ANCOVA test. t value= paired t test.
NS= p> 0.05= not significant. S= p≤ 0.05= significant.

DISCUSSION

The current study was conducted to investigate the effect of bilateral flexible flat foot deformity on knee joint proprioception in weight bearing and non-weight bearing state.

Thirty-two subjects participated in the study with age ranged from 18 to 25 years old. Subjects were assigned into two equal groups; each group consists of 16 subjects. Group (A) (the control group) normal subjects and group (B) (the study group) with bilateral flexible flat foot.

Concerning weight bearing knee reposition sense in flatfoot group and control group as there was no significant difference between them, it is suggested that the NWB knee repositioning procedure had the greatest potential for assessing the proprioception of the tested joint only, while whole limb WB provides the chance for proprioceptive feedback from adjacent joints as hip and ankle joints. Possibly, the sensory areas of the brain may use this information in detecting the location of the knee. (Hanafy, 2017)

A similar explanation to locating the knee joint position during WB joint reposition sense testing may arise from the receptors of the tested foot skin. WB may enhance the afferent signals from compressed mechanoreceptors in the connective tissue structures of the WB joints. (Viseux et al., 2019)

Another possible explanation is that foot dorsiflexion and the resulting calf muscle lengthening which occurs during WB assessment procedures may also play an important rule. As it was concluded by Refshauge and Fitzpatrick that the foot and knee postures, including calf stretch, were the major determinants of the WB and NWB test results.(Refshauge K, 1995). It was previously documented that even a minimum resistance increases the afferent output from muscle spindles, So the greater resistance applied to muscles through

WB position may affect the magnitude of muscle contractions that may affect the proprioceptive acuity (Wilson LR, 1997).

The WB position involved use of the main muscle, tendon, and capsular receptors responsible for joint repositioning and proprioception both in and around the knee joint. These receptors are stimulated by muscle contraction, joint movement, and approximation, which were all part of the WB condition so they may augment the afferent signals concerning joint sense.(Andersen, Terwilliger, & Denegar, 1995)

Regarding NWB knee reposition sense in flatfoot group and control group as there was significant difference between them, there was increase in reposition error in flat foot group. A possible explanation is that due to the interactions of the skeletal system, muscular system, and CNS, dysfunction of any joint or muscle is reflected in the quality and function of others, not just locally but also globally. Muscle and fascia are common to several joint segments; therefore, movement and musculoskeletal pathology are never isolated. Because muscles must disperse load among joints and provide proximal stabilization for distal movements, no movement is truly isolated. (Frank, Page, & Lardner, 2009)

The body When viewed as part of a kinetic chain, the distal end of the lower extremity can be an important investigator in the development and maintenance of pathology throughout the body. The foot is a very important area for proprioception as well as for posture and balance. The foot is the most distal segment in the lower extremity chain and represents a relatively small base of support on which the body maintains balance. Although it seems reasonable that even minor biomechanical alterations in the support surface may influence postural-control strategies (Cote et al., 2005)

Another possible explanation is that a pronated foot is an excessive unwinding of the osteo-ligamentous plate. If the foot biomechanically functions in constant pronation as in flatfoot, the entire leg undergoes excessive internal rotation. The internal rotatory stress or position of excessive internal rotation of the leg may result in several possible problems around the knee (knee valgus), including excessive angulation of the patellar tendon and excessive pressure of the lateral patellar facet. Increasing the angle of incidence of the quadriceps muscle relative to the patella (Q angle) will increase the chance of patellar compression problems. The angle of alignment of the quadriceps; a Q angle of $\geq 20^{o}$ is considered abnormal and creates a lateral stress on the patella. This lead to imbalance between the vastus medialis and lateralis muscles, affect co-

contraction pattern between quadriceps and hamstring muscles and may alter afferent signals concerning joint sense (Page, Frank, & Lardner, 2010).

There is limited research on the effectiveness of flat foot on knee proprioception, the results of the current study concerning WB JPS are similar to those reported by Ghiasi and Akbari (Ghiasi & Akbari, 2007), Stillman and McMeeken (Stillman & McMeeken, 2001), Hyouk Bang et al.(Hyouk Bang D, 2015). These authors found significant increase in the JRS errors during NWB testing. The results of the current study are consistent also with those of Andersen et al.(Andersen et al., 1995), who reported that knee joint angles are more accurately repositioned in the closed chain condition. Additionally, this study is also in agreement with the results found by Bunton et al (Bunton, Pitney, Cappaert, & Kane, 1993). Those authors reported that proprioception is improved by WB because of the proprioceptive input produced by Golgi tendon organs, Ruffini endings, Pacinian corpuscles, and muscle spindles. Which may be another explanation for the greater accuracy of WB testing found in this study.

On the other hand, the reported findings are contradicted with those reported by Kramer et al.(Kramer, Handfield, Kiefer, Forwell, & Birmingham, 1997) and Lokhande et al.(Lokhande et al., 2013). These researchers did not find any significant difference between the WB and NWB testing conditions. Additionally, Lokhande et al.(Lokhande et al., 2013) found a significant increase in the JRS testing errors during WB. These contradictions might be attributed to that our study assess knee JPS in flat foot subjects not in normal subjects.

It was concluded from the results of this study that there was no significant difference between persons with flat feet deformity and normal persons concerning reposition sense of knee joint in weight bearing state, but there was significant difference between them in non-weight bearing state.

This study helped to attract the attention to evaluate the patient's whole posture and not to focus on the symptomatic area as foot posture alterations can produce and maintain long term effects on knee joint. When these changes are overlooked, symptoms referred to other parts of the body continue because their cause, being in the feet, has failed to be properly diagnosed and removed. Further studies are required to investigate the effect of bilateral and unilateral flexible and rigid flatfeet on hip proprioception.

CONCLUSION

It could be concluded that relaxation exercises are more effective than foot reflexology in

decreasing hypertension in postmenopausal women.

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