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# The acute (immediate) effects of reflexology on arterial compliance in healthy volunteers: A randomised study



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## ABSTRACT

**Background:** Reflexology is a widely used complementary therapy. The effects of reflexology on the cardiovascular system are not well characterised. Arterial stiffness (compliance) is a marker of vascular health. This study aimed to evaluate the effects of reflexology on arterial compliance in healthy volunteers. **Methods:** 12 healthy volunteers (1 male; 11 female; mean age  $44.8 \pm 10.8$  yrs) received 10 min of reflexology on each foot in a single-blind randomised study. The main outcome measures were measurements of cardiovascular parameters including heart rate, blood pressure and arterial compliance (augmentation index).

**Results:** Reflexology had no significant effect on heart rate, blood pressure or augmentation index (all  $p > 0.05$ ).

**Conclusions:** In healthy volunteers, there were no consistent changes in haemodynamic parameters with a single brief reflexology treatment. Thus from a cardiovascular point of view, reflexology (as delivered) would appear to have a limited (if any) effect on the cardiovascular system.

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## 1. Introduction

Reflexology is a non-invasive complementary massage therapy, most commonly carried out on the feet [1,2]. It is one of the most popular forms of complementary and alternative medicine in the UK and is also widely used by patients [3]. Reflexology is based on the idea that the feet offer a perfect scaled-down representational template of the human body as a fundamental biological design [2]. Reflexologists believe that each body part, gland, and organ, has a reflex point on specific areas of the surface of one, or both feet, most typically on the planter surface [4]. These points form a map of the body on the feet; the left foot corresponds to the left side of the body, and the right foot, to the right side of the body [1]. Reflexologists work on the premise that massage to reflex points increases blood supply to the corresponding or 'mapped' organ in the body [4]. Currently, there is little evidence to prove its efficacy and

safety and yet there is considerable money spent by individuals on this therapy [5]. Thus, there is a need for conclusive evidence to back up the claims about the effects of reflexology for both ethical and financial reasons.

Previous research into the acute cardiovascular effects of reflexology demonstrated a small decrease in cardiac index in the intervention treatment, when reflexology was applied to the upper part of the left foot in healthy volunteers [6]. Despite a considerable degree of diversity in reflex point placement in published reflexology foot maps, in our previous survey of Association of Reflexologist (AoR) practitioners, the majority of UK practitioner respondents reported that they placed the heart reflex point within this area [5,6]. One possible mechanism to explain the decrease in cardiac index is that arterial compliance could have been affected (reduced).

Arterial compliance is increasingly recognised as a marker of vascular health. It can be defined as the increase from the first, to the second systolic peak in the pulse waveform. Pulse wave analysis, (PWA) (e.g. using a sphygmoCor device) can be used to estimate arterial compliance. This involves placing a tonometer transducer on the skin surface, over the point of the radial pulse to

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obtain the pulse waveform. From this, the augmentation index is calculated, providing a measure of arterial compliance [7]. Studies have shown that arterial compliance decreases with age [8], in type 2 diabetes [9], in hypertension [10] and can be used to predict outcome after stroke [11]. It has also been shown that some treatments can improve arterial compliance, such as antihypertensive drug therapies, including calcium channel antagonists, angiotensin converting enzyme inhibitors, and angiotensin receptor blockers [12]. Thus, there is a link between cardiovascular health, but also interventions, and changes in arterial compliance.

This current study aimed to assess the acute (immediate) effects of reflexology on arterial compliance in healthy volunteers.

## 2. Methods

### 2.1. Design

Single-blind randomised control study.

### 2.2. Participants & recruitment

Participants were deemed eligible for the study if they were over 18 years old, able to give written consent, had normal lower limbs (no major surgery) and had a suitable radial pulse for PWA. Participants were excluded from the study if they were participating in a pharmacological study or had a history of cardiovascular disease or neuropathy. Participants were identified by self-referral following recommendation from existing healthy volunteers and by self-response to a poster.

### 2.3. Randomisation and protocol

In order to adjust for a possible treatment order effect, participants were randomised to receive reflexology to either the right or left foot first. The randomisation was performed using a computer generated random number generator (<https://www.random.org/integers/?num=12&min=1&max=12&col=1&base=10&format=html&rnd=new>).

The treatments were administered in a quiet, dimly-lit, temperature controlled environment. Each participant was given a blanket to cover them throughout the treatment. The foot treatment order was randomised to control for any treatment order effect.

Participants were each asked to attend one study visit lasting approximately 1 h. Upon arrival, the entire procedure was explained. Their height and weight were recorded and BMI calculated before the procedure began. The participants then lay on the bed with a pillow below their knees and rolled up sheets below each ankle. A blood pressure cuff was placed on the left arm and the subject was covered with a blanket. The researcher (KR) explained that there would be no talking during data recording. Dialogue between the researcher and the reflexologist (NS) was also kept to a minimum. The researcher did not see the feet during the measurements and was thus blinded to treatment order. There was a minimum of 20 min stabilization period before baseline measurements were taken. Cardiovascular measurements were made on 4 separate occasions at 10 min intervals in each participant, (baseline, after left and right foot reflexology in random order, and at recovery). The random order allocation list was handed directly to the reflexology therapist in a sealed envelope. The researcher did not have access to the allocation list until data recording was complete. Thus the researcher was blinded to the order of treatment.

### 2.4. Intervention

Reflexology was applied to each foot as described in Fig. 1 for 10 min in a randomised order. There is marked divergence in the types of treatment techniques and approaches used in reflexology massage treatments [24]. The UK Reflexology Forum council, the voluntary regulator of the profession, promotes a “core curriculum” reading list [13]. Key authors on this list appear to suggest or recommend contradictory reflexology treatment sequences and differing physical massage techniques (which are intended to ‘stimulate’ or ‘sedate’) for the same conditions [14–17]. Indeed, Hall [18] acknowledges that various forms of treatment structure exist and that different training schools teach different versions. She does not see this as a problem and believes the end results will still be beneficial regardless. Kunz and Kunz also state that treatment can start with either foot, as it is a “matter of personal preference” [19]. Regardless of the inconsistencies in strategies and techniques of these reflexology authors on the core curriculum list, one consistent theme emerges from the majority of authors. This is the general treatment sequence, which typically starts with the toes, then moves to the ‘shoulder girdle’ region (the upper third of the foot), then the ‘abdominal’ region (middle plantar region) and concludes with the ‘pelvic’ girdle zone (heel) and ankle area. Therefore this general flow of treatment acted as the guide for the intervention and given the lack of consistency over which foot should commence a treatment, the Association of Reflexology Research Support Manager collaborated with the reflexology intervention design and confirmed that our randomized treatment order, treatment sequence and reflexology massage techniques retained content validity of the practice (Table 1). This ensured that the intervention could still be distinguished as being reflexology rather than simple foot massage [20]. The reflexologist in this current study used standard Ingham’s touch techniques.

### 2.5. Measurements

Cardiovascular measurements were made at baseline and at 10 min intervals for 30 min. Measurements included PWA (SphygmaCor, SCOR-Px, AtCor Medical); measurements of augmentation index (AIx) standardised to a heart rate of 75 were used as a measure of arterial compliance. Measurements had to have an operator index (measurement of quality) of 80% or above to be accepted [21]. Systolic blood pressure (sBP), diastolic blood pressure (dBP) and heart rate were measured with a Nihon Kohden (VISMO PVM-2701) monitor.

### 2.6. Data handling and analysis

Data consisted of baseline, intra-treatment (on each foot) and post-treatment measurements, collected in distinct 10 min measuring phases. For each measurement, the mean and standard deviation (SD) was calculated. One way ANOVA with repeated measures was used, with significance taken at the 5% level.

### 2.7. Sample size

There are no data regarding the potential magnitude of any specific effects of reflexology on arterial compliance, therefore data were extracted from our earlier research studies for the power calculation based on changes in other parameters [6]. This pilot study data showed that cardiac output decreased in the intervention group with a mean difference of 0.26 L per min; (SD 0.32). A retrospective power calculation (Minitab version 16.1.1.1 Microsoft, Redmond, Washington, USA) determined that in order to detect a

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